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AN ASSESSMENT OF TECHNICAL REPORTS AS A PERFORMANCE MEASURE FOR THE NAVAL AVIATION ENGINEERING SERVICE UNIT (NAESU)

by

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AN ASSESSMENT OF TECHNICAL REPORTS AS A PERFORMANCE MEASURE FOR THE NAVAL AVIATION ENGINEERING SERVICE UNIT (NAESU)

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ABSTRACT

This thesis is an assessment of technical reports as a method for measuring the performance of the Naval Aviation Engineering Services Unit (NAESU). Six technical reports are used to address the primary question asked in this thesis: Do NAESU technical reports provide tangible cost savings through improvements to the reliability and maintainability of aircraft weapons systems. Useful maintenance data pertaining to the items of interest was extracted from the Naval Aviation Logistics Data Analysis (NALDA) system. Cost data was taken from the Aviation Supply Office (ASO) master files. Based on the author's analysis, the cost savings from improvements in reliability and maintainability can be determined for each technical report.

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I. INTRODUCTION

A. BACKGROUND

The Naval Aviation Engineering Service Unit (NAESU) provides Engineering and Technical Services (ETS) to both Navy and Marine aviation communities. Its mission is

> ...to provide advice, information, instruction, and training in the installation, operation, modification and maintenance of aircraft systems and equipment. [Ref. 1]

These services are provided by qualified DOD military and civilian personnel and by employees of private sector companies.

In 1992 and 1993, the 102nd and 103rd Congress conducted hearings to discuss growing concerns over the performance of Federal Government agencies. To this end, they passed Public Law 103-62, better known as the Government Performance and Results Acts of 1993. From Congressional hearings and committee meetings, they determined: [Ref. 2]

- Federal managers are seriously disadvantaged in their efforts to improve program efficiency and effectiveness, because of insufficient articulation of program goals and inadequate information on program performance; and

- Congressional policy making, spending decisions and program oversight are seriously handicapped by insufficient attention to program performance and results.

Based upon these findings, the act included provisions to:

- Require each Federal agency to submit to the Office of Management and Budget (OMB), beginning in 1997, a five-year strategic plan for agency programs, to be updated at least every three years.

- Direct the Federal Government to submit to Congress, starting in FY99, an annual performance plan as part of the Budget of the United States.

With this law as a benchmark, Department of the Navy has begun the task of determining measures of performance for each of its components. Taking the lead, the Naval

Aviation Engineering Support Unit (NAESU) is currently sponsoring on-going research to determine specific performance measures for their organization. This thesis is a continuation of research begun by the Defense Resources Management Institute and the Naval Postgraduate School in 1992 at the request of the Commanding Officer, Naval Aviation Engineering Service Unit.

The author will utilize NAESU Technical Reports (NTR) as a means of measuring performance of NAESU. Specifically, it will examine reports generated by ETS representatives, also known as "techreps", to determine their correlation to cost savings brought about by specific improvements in the reliability and maintainability of aircraft weapons systems.

Reliability and maintainability are but two of eleven factors addressed in logistics. Logistics accounts for all necessary considerations to assure effective and economical support of a system throughout its programmed life cycle. [Ref. 3] Both reliability and maintainability criteria are specified during acquisition of the weapons system and as such are measurable attributes. This thesis focuses on the cost savings associated with achieving improvements in reliability and maintainability.

Weapons systems should be designed to be maintained without large investments of time, money or other resources (e.g., personnel, materials, facilities, test equipment) and without adversely impacting the mission readiness of that system. In determining support requirements, the frequency of maintenance due to systems failures becomes a significant parameter. The frequency of maintenance for a given item is highly dependent on the reliability of that item. In general, as the reliability increases, the frequency of maintenance will decrease and, conversely, the frequency of maintenance will increase as system reliability is degraded. Reliability is a design characteristic which measures the failure rate, or length of time between maintenance actions. On the other hand, maintainability is an inherent design characteristic dealing with the ease, accuracy, safety, and economy in the performance of maintenance functions.

Since NAESU techreps are located at various locations worldwide, they are in a unique position to report information which can be used to improve methods and eliminate

of time between maintenance actions. On the other hand, maintainability is an inherent design characteristic dealing with the ease, accuracy, safety, and economy in the performance of maintenance functions.

Since NAESU techreps are located at various locations worldwide, they are in a unique position to report information which can be used to improve methods and eliminate deficiencies which have life long effects on reliability and maintainability. Techreps write about problems from the perspective of years of experience on aircraft weapons systems. The information they document is submitted formally as NAESU Technical Reports (NTRs). These reports are important means of communication by which the Navy and contractors are informed of technical problems, and, quite often, provided with acceptable solutions. NTRs deal with subjects of interest or concern to other Fleet activities and commands and to system support and management activities such as the Commander, Naval Air Systems Command. From these reports, program managers determine if changes to maintenance procedures or modifications to aircraft weapons system components are warranted.

B. OBJECTIVES

The objectives of this thesis are to:

- Describe the process by which techreps provide inputs for improvements to maintenance procedures, and modifications to aircraft weapons systems.
- Examine the NAESU Technical Report Record and Retrieval System data base to extract detailed information on those NAESU technical reports which relate to aircraft weapon's systems and to identify problems associated with gathering meaningful information from the data base.
- Examine data bases available for extracting reliability and maintainability information concerning aircraft weapon's systems and to identify problems associated with gathering meaningful information from these data bases.
- Determine the cost savings from improvements in reliability and maintainability of a sampling of NAESU technical reports for aircraft weapons systems.

- Refine the methodology for analyzing NAESU technical reports for determination of their contribution to cost savings in the Naval Aviation community.

C. PRIMARY RESEARCH QUESTION

Do NAESU Technical Reports provide tangible cost savings through improvements to the reliability and maintainability of aircraft weapon's systems?

D. SCOPE, LIMITATIONS AND ASSUMPTIONS

The research effort is focused on a sampling of NAESU Technical Reports (NTRs) that affected various aircraft. The reports and their related feedback responses were selected from a cross-reference listing of those published by NAESU in "Technotes", a monthly compilation of NTRs submitted to NAESU headquarters during the month. The listing covers a period from 1973 to 1994, but is not all inclusive of the reports written during that period. Appendix A is a list of 199 of over 2,200 NTRs that sparked the author's interest during his review of NTRs at headquarters.

This thesis is limited to recommendations that were justified by NAESU Technical Reports and approved by both the Cognizant Field Activity (CFA) and Program Manager. The author recognizes other sources of information from the Naval Aviation Maintenance Discrepancy Reporting Program (NAMDRP), such as the Hazardous Material Report (HMR), Engineering Investigation (EI), Quality Deficiency Report (QDR), and Technical Publication Deficiency Report (TPDR) which also provide inputs for consideration to the change process.

Assumptions made in this thesis are: 1) the problems reported by ETS representatives are being experienced Fleet-wide due to common deficiencies; 2) no other change action was implemented during the period of analysis for each NTR; and 3) consumable repair part costs are negligible.

E. LITERATURE REVIEW

An extensive literature review failed to locate previous research that assessed the correlation between external technical support and the overall reliability and maintainability of aircraft weapons systems. The literature review attempted to locate studies from private industry as well as from government agencies, both without success. The author used several references which formed the foundation for several theses in the area of the Component Improvement Program (CIP). From these, data research methodologies and modeling techniques were adapted for use in determining changes in reliability and maintainability and resultant cost savings.

F. ORGANIZATION OF STUDY

Chapter II provides background concerning the history of NAESU, the responsibilities of ETS, NAESU Technical Report guidelines, a description of the Cognizant Field Activity Program, procedures for processing ETS Technical Reports, and measures of performance. Chapter III details the data collection process. Included in Chapter III is the process used to locate NTRs and their respective feedback reports as well as maintenance data. Chapter IV details the methodology used by the author to select candidates for study and to construct a life-cycle cost analysis model for conducting research.

Chapter V presents the data collected from each NTR including specific background information and an analysis of related maintenance data relating to each NTR to determine its effect on the reliability and maintainability of the item, and a determination of its associated cost savings. Chapter VI presents a summary, conclusions, and recommendations for future study.

II. BACKGROUND

The purpose of this chapter is to provide the reader with: 1) A brief history of NAESU to understand the evolution of its missions and roles; 2) Information about ETS and their specific responsibilities; 3) A detailed narrative describing the format of NAESU Technical Reports (NTR); 4) A discussion of the Cognizant Field Activity (CFA) program to gain a perspective on the responsibility for reviewing, approving or disapproving recommendations provided in NTRs; and 5) The procedures for processing NTRs.

A. A BRIEF HISTORY OF NAESU

During World War II, there emerged a demand for the installation of aircraft search radar, radar altimeters and new electronic devices. As the installations were completed, Naval Aviation was forced into an expanded and challenging era of increasingly technical maintenance. In response to that challenge a pool of highly trained military radar specialists whose services were available upon demand was established. Their mission was to assist in the installation, operation and maintenance of this complicated new equipment. The specialists were available for tours of temporary duty for two to four months during which time they would indoctrinate and provide on-the-job training to Navy and Marine Corps personnel. Between assignments, they returned to home base for refresher courses and training in the latest equipment modifications. This pool of specialists led to the establishment of a new organization, the Airborne Coordinating Group (ACG) located at the Naval Research Laboratory in Washington, D.C.

It was determined that the demand for qualified Navy technicians critically exceeded the availability of those within the nucleus of military personnel, so aerospace manufacturers supplied field technicians to work with the Navy technicians. In January, 1943, approximately thirty civilian contractor technicians and a few Navy technicians comprised the ACG. By

1944, the demand for service led to an increase of 200 civilian contractor technicians and 60 Navy technicians. By that time they had completed more than 1,500 tours of duty.

The ACG's establishment and continued existence was further solidified as evidenced by an increase of personnel by post war time frame to include the participation of Civil Service Personnel. In 1948, the ACG was renamed the Naval Aviation Electronics Service Unit, with an expanded mission to support all types of aviation systems and equipment. The expansion was based on the deterioration of general readiness conditions of electronics equipment and growing shortage of technical personnel. Consequently, these technicians found themselves gradually shifting from specialists on specific types of equipment to general technicians on any and all types of aviation systems and equipment. Training policy changes gave the technicians increased involvement with all types of equipment.

In January, 1959, the Secretary of the Navy directed that the organization's name again be changed to the Naval Aviation Engineering Service Unit (NAESU) and reaffirmed the mission to provide field engineering assistance and instruction to Naval Aviation activities in the installation, maintenance, repair and operation of all types of aviation systems and equipment. Within the scope of the administration of Engineering Technical Services (ETS) was the procurement of technical services from aerospace manufacturers in the form of Contractor Engineering Technical Services (CETS). These personnel were also located on site at each of the Naval Air Stations. As technology developed and became more sophisticated, Naval Air Stations located throughout the world realized the critical need to have continued on site support by the NAESU technician. To handle an expanding work force resulting from its extensive demand for technical support, NAESU was administering 492 field technicians.

By 1962, two field detachments: NAESU Detachment ONE, located at the Naval Air Station, North Island, California; and NAESU Detachment TWO, located at Naval Air Station, Norfolk, Virginia, were providing regional support for NAESU Headquarters located at the Philadelphia Naval Base. Gradually, NAESU detachment offices were established across the United States and beyond to both Europe and Asia. As the progress of detachment establishment evolved, the technical and administrative responsibilities of NAESU

Detachments ONE and TWO increased and they became the regional area of authority enhancing the focus on detachment offices located on the West Coast and in Asia, and on the East Coast and in Europe, respectively. Eventually, the Southern Regional Office was established in New Orleans, Louisiana, as the focal point for all Reserve Aviation activities. NAESU detachment offices currently number more than 40 worldwide. In 1966, Naval Air Systems Command (NAVAIR) established NAESU as the major supplier and administrator of ETS, for Aviation Maintenance Support.

B. ENGINEERING TECHNICAL SERVICES

Engineering Technical Services consists of information, instruction and training provided to DOD personnel ashore and afloat in the installation, operation and maintenance of aircraft weapons systems and related support equipment. ETS are interim instructional services tailored to a specific requirement. Colon [Ref. 4] concluded ETS meets the criteria as a logistics element. As a logistics element for naval aviation, NAESU ETS are required to: [Ref. 5]

- Accomplish the initial transfer of knowledge from equipment manufacturer to organic Navy during equipment introduction to fleet units.
- Provide on-the-job training and assistance to untrained personnel.
- Enhance the classroom experience of newly trained maintenance technicians by elevating their technical skills to required levels.
- Provide assistance for resolution of unusual or difficult maintenance problems.
- Maintain technical information channels and liaison between the manufacturer and the Navy.

ETS will be used primarily to complement FRAMP, MTIP, and shore based turnaround training. They are not intended to be a corrective measure for inadequate integrated logistics support (ILS) planning, funding or execution. Use of ETS aboard ship

during routine aircraft carrier or carrier air wing work-up training periods and short-term assists is an Aircraft Controlling Custodian (ACC)/Type Commander (TYCOM) management option. Normally ETS will not be embarked for extended deployment. In those instances where actual, unavoidable logistic, personnel or training deficiencies exist, ACCs/TYCOMs may continue to deploy ETS on a limited basis. Such support will be restricted to fact-of-life cases where that option is the most logical, cost-effective alternative. Use will be closely monitored and limited to an absolute and justifiable minimum. ETS will not be used to: [Ref.5]

- Perform maintenance or inspections of any type.
- Install engineering changes.
- Obtain replacement parts and material.
- Arrange for shipment of defective components.
- Avoid manpower ceilings or other personnel rules and regulations of the Office of Personnel Management, DOD and the Department of the Navy.

Initial ETS requirements will be included in appropriate integrated logistics support (ILS) and phased support plans. From these, long term programmatic ETS support plans will be developed by NAESU in conjunction with individual fleet customers, ACCs/TYCOMs, and the NAVAIR Assistant Program Manager for Logistics (APML). These plans will document requirements by site or billet and will be used to justify budget requests and allocate available resources. [Ref. 5]

Engineering Technical Services are performed by NETS, who are organic Navy personnel (military and civilian) and by contractor ETS (CETS) who are commercial or industrial contractor personnel. [Ref. 6] As shown in Figure 2.1, NETS are further divided

into Navy Military Technical Specialists (NMTS) and Navy Civilian Technical Specialists (NCTS). NMTS are made up of active duty and reserve military personnel. These sailors

DOD (NETS)

- Civil Service (NCTS)
- Military (NMTS)

CONTRACTOR ETS (CETS)

- Contractor Field Support (CFS)
    - Competitive (CFSC)
    - Prime (CFSP)
- Contractor Plant Services (CPS)

Figure 2.1. Engineering Technical Services

possess in-depth knowledge of a particular weapons system or component and act as subject matter experts who fill the role and duties of an ETS member. NCTS are civilian employees who work for the military as civil servants. They are managed by the Navy and fall under the General Schedule (GS) rating system. They, too, are technical specialists with special qualifications which allow them to provide information, instruction and training. In general, the duties and responsibilities of NETS personnel fall into the following categories:

- Furnishing on-the-job training and classroom instruction to Navy and Marine Corps personnel in the installation, operation, maintenance and repair of aviation systems and equipment.

- Detecting technical deficiencies in the maintenance and operation of aviation systems and equipment and determining methods by which those deficiencies can be eliminated.

- Investigating failures of equipment and demonstrating to military and civil service personnel the means and methods for overcoming failures.

- Assisting in the installation of aircraft maintenance equipment, shipboard and ashore, and providing on-the-job training to appropriate military and civil service personnel.

- Solving specific maintenance problems and providing technical information to naval and other DOD activities.

- Submitting technical reports as required.

As is also shown in Figure 2.1, CETS are further divided into Contractor Field Service (CFS) and Contractor Plant Services (CPS). CFS are provided to user activities on site at designated military locations by prime contractors (CFSP) or through competitive procurement (CFSC). CFS's function as follows:

> CFS personnel provide technical information, liaison as required, and formal, structured, and on-the-job training. They possess specialized knowledge, experience, and skills and have access to information covering the installation, operation, modification, and maintenance of DOD weapons, equipment and systems. [Ref. 1]

CPS are provided to user activities at the contractor's plant or at another designated facility, and provide:

> ...training courses, training aid programs, system/component knowledge, and other essential skills relating to the development of the technical skills required for installing, maintaining and operating such equipment. [Ref. 1]

Both types of CETS may be continued after introduction to fleet activities. Normally the use of CETS will not exceed 12 months after Navy Support Date (NSD). Exceptions to this limitation may be approved on an individual basis by NAESU as delegated by the Commander, Naval Air Systems Command in the event logistic deficiencies jeopardize achieving mission goals. Exceptions may not exceed 12 months.

C. NAESU TECHNICAL REPORT GUIDELINES

A primary source of information which can be used to improve methods and eliminate deficiencies in the area of aviation maintenance is the NAESU Technical Report (NTR). This report is an important means of communication by which the Navy and contractors are informed of technical problems and, quite often, provided with acceptable solutions. Frequently, the people who read the report and are required to take action on its content have never seen the equipment. This makes it paramount for the reports to be clear and concise. The importance of these reports should never be underestimated as they are an integral part of the duties and responsibilities of NETS/CETS personnel. Specific criteria and format for submission of NTRs are provided in References 7 and 8.

Submission of reports is typically left up to the individual ETS representative, although at times, a Fleet command may request them to submit a report relating to a specific deficiency discovered at their command. Figures 2.2 and 2.3 depict the mix of NTRs submitted by each detachment and by each program for 1994. Some of the subject areas suitable for reporting are:

- Conditions which present a hazard to personnel or equipment.
- Safety of flight conditions.
- Frequent occurrence of the same or similar problems which indicate that a defect, incompatibility or deficiency exists in a technical or logistical area.
- Technical problems whose solutions are beyond the capability of the local activity.
- Discrepancies found in new installations or authorized changes to an equipment or system.
- Modifications developed in the field to improve equipment performance or maintainability.
- Recommendations for new or improved operating procedures.
- Evaluation of equipment, handbooks and procedures.

- Evidence of improper quality control in maintenance, rework or manufacture of components and/or parts and improper handling, packaging or shipping.

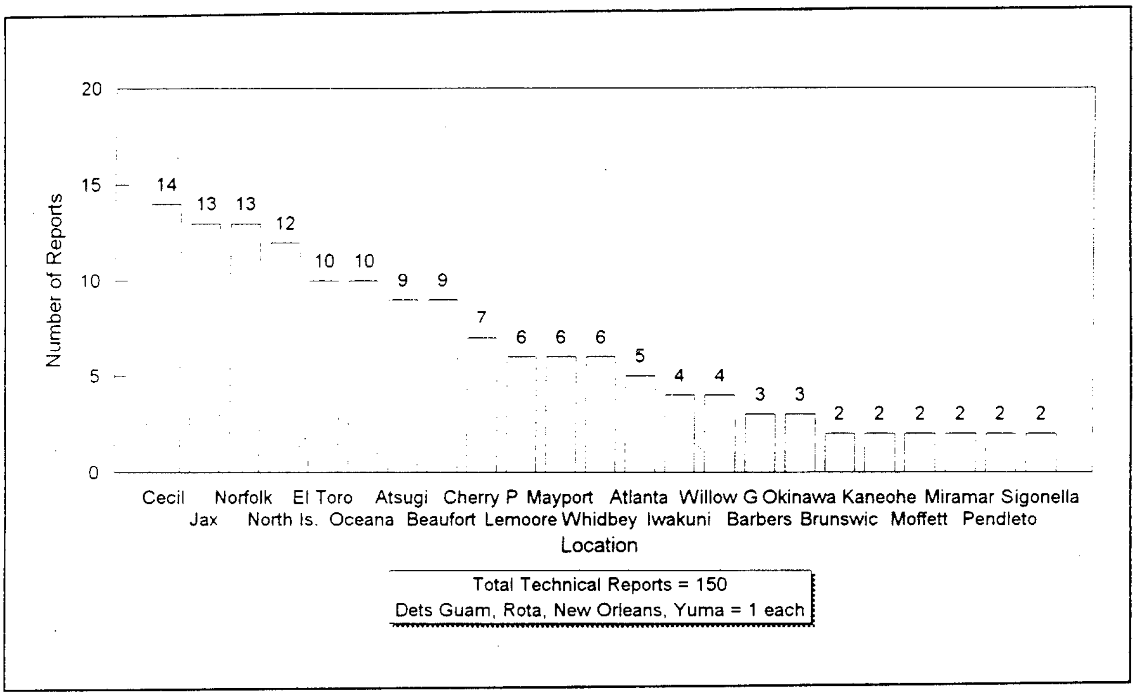

Figure 2.2. Fiscal Year 1994 Technical Reports by Detachment

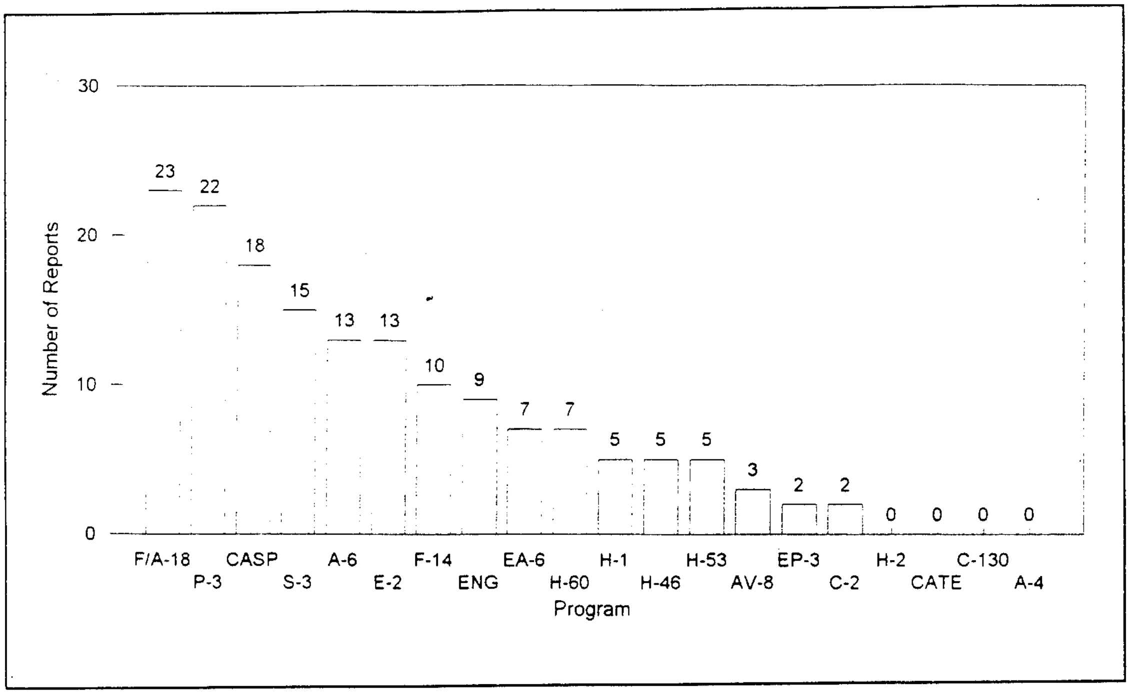

Figure 2.3. Fiscal Year 1994 Technical Reports by Program

D. COGNIZANT FIELD ACTIVITY PROGRAM

Cognizant Field Activities (CFA) are those activities which have been assigned the responsibility and delegated the authority by Naval Air Systems Command Headquarters to perform all or portions of the in-service functions consisting of the totality of logistics management and basic design engineering, including procurement support, which are required to be performed for a service equipment in order that it may continue to operate properly and perform useful functions throughout its service life. [Ref. 9] Designation of the prospective CFA will be accomplished as early as possible in the life cycle of the equipment but not later than equipment introduction to the fleet. Service equipment included in the CFA program

includes those aircraft, target, drone, and other airborne shipboard, and shore based systems and their included supporting subsystems, equipment, components, software, and related support equipment, including related test program sets.

Frequently, Naval Aviation Depots (NADEP) are assigned as CFAs for service equipment, as is the case for all of the equipment reported in the NTRs selected for analysis in this thesis. Depot (D-) level industrial functions consist of three general categories:

- Those involved in the rework of existing aviation end items, systems, components, and support equipment. This includes maintenance and modification functions.
- Those involved in the manufacture of items and component parts otherwise not available.
- Those involved in support services functions which include professional engineering, technology, and calibration services.

The third category relates to those functions performed while acting as the CFA. These functions encompass all efforts for the assigned service equipment to: 1) support and maintain the intended mission capability; 2) maintain inherent design capabilities of the service equipment at the minimum expenditure of resources; 3) preserve the planned operational life; and 4) achieve readiness goals. This effort is accomplished through application of design, maintenance and logistic principles.

The CFA program most directly affected by NTRs is In-Service/Reliability Centered Maintenance (ISE/RCM). This program consists of a number of functions which gather information which in turn define evolving technical requirements relating to specific aircraft/systems/equipment. These functions encompass all efforts: [Ref. 5]

- To support and maintain the intended mission capability.
- To maintain inherent design capabilities of the systems/equipment/aircraft at the minimum expenditure of resources.

- To preserve the planned operational life.
- To achieve readiness goals.

E. PROCESSING NAESU TECHNICAL REPORTS

It is the policy of the Commander, Naval Air Systems Command to maintain aircraft and their related equipment and material so as to ensure maximum readiness at all times. NETS are in a position to develop and report information which can be used to improve methods and eliminate deficiencies in equipment [Ref. 9]. It is incumbent upon CFAs to utilize this valuable information. To this end, NAVAIR: 1) emphasizes the need for prompt disclosure of vital information provided by NETS personnel; 2) establishes a channel for the collection of data from NETS; and 3) establishes effective follow-up action in order to realize tangible benefits.

Upon receipt, the CFA must review all NTRs and take steps to correct disclosed discrepancies or items requiring expeditious actions. The CFA is directed to provide the originator of the NTR and NAESU Headquarters the proposed or final disposition on the report within 60 days. The CFA has sole authority for communications with contractors or other activities regarding these reports. NTRs not only report the problem, describe the equipment, and give detailed analysis, they often provide tested solutions to the problem. Solutions to problems take many forms, but most often they are changes to maintenance procedures published in technical manuals. Figure 2.4 is a listing of CFA action codes, with the associated number of actions taken on the NTRs reviewed by the author.

Action Code:	Number of Actions
(0) - Submitted to CFA.	1
(1) - Affirmative action completed.	1
(2) - No action required (misc. info published in Technotes).	0
(3) - Negative action completed. NTR recommendation rejected.	46
(4) - Negative action recommended by other than CFA.	0
(5) - Recommended by CFA, action dependent on another activity.	1
(6) - Recommended by CFA, action scheduled for completion.	0
(7) - Review by other than CFA initiated.	0
(8) - Referred by CFA to another activity.	0
(9) - Review initiated by CFA.	0
(10)-Review Pending	6
(A) - Publication Change	14
(B) - Maintenance Procedure/Publication Change	54
(C) - Equipment Modification/Specification/Pub. Change	15
(D) - Equipment Defect	9
(E) - Maintenance Level Change	1
(F) - RAMEC	2
(G) - Test Program/Software Change	17
(H) - Equipment Test Procedure Change	4
(I) - Material Deficiency	3
(J) - Change to Technical Directive	1
(K) - Beneficial Suggestion	0
(L) - Storage Procedures	1
(M) - Supply Assist	6

Figure 2.4. CFA Technical Report Action Codes

F. MEASURES OF PERFORMANCE

As mentioned in Chapter I, the major focus of this thesis is to determine a measure of performance for NAESU. Boynton [Ref. 10] determined performance measures of techrep organizations encompass a wide variety of areas which add value to the Department of Defense (DOD). An example cited was the ability of techreps to determine a procedure to

repair an item locally that would otherwise have required depot repair. Significant savings were realized as a result of techreps intervening so as to avoid depot or contract repair costs. Techreps, through their years of experience, are aware of equipment that could possibly be repaired at lower levels of maintenance with potentially significant savings to the government. Although most references appear to focus on training as the primary responsibility of the techrep, other activities provide a tremendous contribution to the aviation maintenance community. As Boynton [Ref. 10] further states:

> Performance measures developed for techrep organizations must take cognizance of these seemingly peripheral activities.

Reliability and maintainability can be used as performance measures because they are each tangible attributes of any piece of equipment in the Navy's inventory. Reliability is defined as the probability that a system or product will perform in a satisfactory manner for a given period of time when used under specified operating conditions. [Ref. 3] Reliability is the underlying factor in determining the failure rate of the weapons system. Maintainability, on the other hand, is defined as the ease, accuracy, safety and economy in the performance of maintenance actions. [Ref. 3] Systems should be designed to be maintained without large investments of time, money or other resources (e.g., personnel, materials, facilities, test equipment) and without adversely impacting the mission readiness of that system. Again, the time element can provide a measure of system performance. Maintainability is a characteristic designed into an item which can be defined through the level of maintenance performing repair actions, maintenance frequency, maintenance times (i.e., elapsed times and labor-hours), and maintenance cost.

III. DATA COLLECTION PROCESSING

A. NAESU TECHNICAL REPORTS AND RELATED FEEDBACK

Initially, the author's focus was on those NAESU Technical Reports (NTR) which resulted in Engineering Change Proposals (ECP) on the related system. ECPs are proposal documents which direct and provide instructions for the accomplishment of changes, modifications, repositioning, or alteration of material in-service aircraft, weapon systems, assemblies, subassemblies, components, or support equipment. [Ref. 6] The author visited with the Officer-in-Charge of NAESU Detachment, Naval Air Station, Lemoore, CA, CWO4 Adams [Ref. 11], to establish the baseline for future research relating to NTRs. He provided copies of all references applicable to the ETS, and copies of recently published "Technotes", a publication printed monthly by NAESU headquarters, which contained several NTRs written by techreps in his detachment.

The techreps at NAESU Detachment, Lemoore, provide ETS for the Navy's west coast F/A-18 community. As one of the newest and most technically complex aircraft in the Navy's inventory, one would expect there would be numerous NTRs available for study at this site alone. Unfortunately, this was not to be the case. Numerous NTRs had been submitted, yet, records of feedback reports, in particular, those with actions resulting in ECPs, were not available. An interview with Mr. Tom Ford [Ref. 12], the ETS supervisor, revealed most feedback was received through telephone conversations between techreps and their Cognizant Field Activity (CFA) counterparts. If the discrepancies discovered significantly affect aircraft maintenance, CFAs take immediate action to resolve the discrepancy and rarely provide formal feedback reports.

The author contacted the Commanding Officer of NAESU, CDR Van Sickle, to request permission to use his staff for thesis research [Ref. 13]. He approved the request and Mr. Ron Rush, Program/Management Analysis Officer was tasked to assist the author in

obtaining copies of the F/A-18 aircraft NTRs and feedback reports from which CFA ECPs were initiated. Reports received were forwarded to the author, but upon review, none had resulted in ECPs.

The author visited NAESU headquarters to conduct further research using the NAESU Technical Report Record and Retrieval System data base, and was put in contact with Mr. Al Tentilucci, Supervisory Management Analyst, and Ms. Rita Acquarolo, Management Analyst. When interviewed about this data base [Refs. 14 and 15] they informed the author the system had only been implemented in 1993, and was simply a data base program constructed by a staff member. The author was informed this staff member had been out of the office for medical reasons since November 1994, so not be available for an interview.

Upon review of the data base, the author discovered the available data was insufficient for study, so decided to review as many copies of "Technotes" as possible in the constrained time of the visit. Ms. Acquarolo provided the author copies of the master index of NTRs which covered all published reports from 1973 to 1994. The master indices were formatted by author's name and by system nomenclature, which was most useful in determining who wrote each NTR, and when each was written and published. Unfortunately, there was no reference to CFA feedback reports in the indices. Appendix B shows the format used by NAESU to index NTRs. The author reviewed all NTRs published between 1981 and present. As it were, all were intact, but the only years CFA feedback reports had been included were from 1986 to 1988.

The author consulted with Mr. Tentilucci and determined the best course of action was to limit the scope of study to a specific period and to divert the focus from NTRs relating to ECPs to those that possibly contributed to improved reliability and maintainability of an aircraft weapons system. To this end, NAESU requested all detachments provide copies of all NTRs and their respective CFA feedback reports for the period from 1986 to 1988.

B. MAINTENANCE DATA SOURCES

There are numerous data bases available for use that collect maintenance related statistics. Jones [Ref. 16] listed over 19 data bases of interest in his efforts to determine the benefits of the Component Improvement Program (CIP) to the J-52 engine. Most beneficial to his research was the Naval Aviation Logistics Data Analysis (NALDA) data base, which this author chose as his primary source of maintenance related data. This data base is derived from maintenance documentation completed at both Organizational (O-) and Intermediate (I-) level maintenance activities.

C. LABOR RATES FOR "O" AND "I" LEVEL MAINTENANCE

Labor costs at an hourly rate for O- and I-levels of maintenance were acquired from the Visibility and Management of Operating Support Cost (VAMOSC) data base. [Ref. 17] The labor rates acquired were for the years 1979 up to and including 1993. The labor rates for 1994 and beyond were estimated using a 6.1% estimate which was the average over the last four years. This method was also used by Jones [Ref. 16] and Murphy [Ref. 18].

D. MATERIAL/DEPOT REPAIR COSTS

Material costs were determined through use of the Navy's FEDLOG program. FEDLOG is an interactive CD-ROM based data retrieval system which contains pertinent supply data including part numbers, federal stock numbers, unit of issue, unit price, net price, and more. Depot repair costs were determined through use of the Aviation Supply Office (ASO) master files. One module of this, called "Snapshot", includes the current repair cost for each repairable item. In addition, the author contacted item managers to validate the master file data. Item managers are responsible for determining stock requirements for specific items that are used in support of all naval activities.

IV. METHODOLOGY

A. CHOOSING CANDIDATES FOR STUDY

As mentioned in Chapter III, the author chose to focus on NTRs published during the period between 1986 and 1988 because these NTRs and their related feedback reports had been published in NAESU Technotes on a regular basis. After the second data call by NAESU Headquarters, the author obtained several other NTRs and their respective feedback reports, some of which will be used in this thesis for analysis. In total, the author collected 199 NTRs for review. Figure 4.1 relates the breakdown of these by NAESU program.

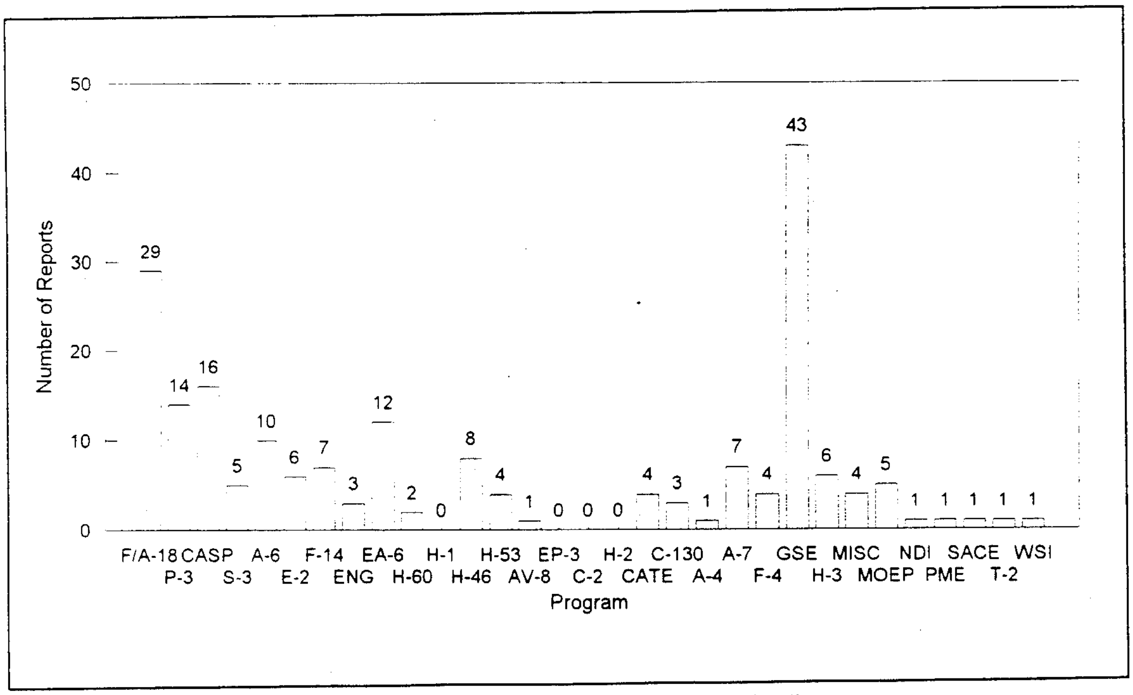

Figure 4.1. Technical Reports of Interest by Program

Upon review, the author discovered actions taken on NTRs by CFAs were quite varied, ranging from no action to major equipment modification. Figure 2.4 relates the number and type of action taken for the NTRs reviewed. As can be seen, over one-third

resulted in maintenance procedure/publication changes. It was this type of CFA action that determined the criteria for selection of sample NTRs. From over fifty NTRs meeting this criteria, the author chose at random six for in-depth analysis to determine if they provided tangible cost savings through improvements to the reliability and maintainability of aircraft weapons systems.

B. COLLECTING MAINTENANCE DATA

The author visited ENS Rebecca Kirk, Quality Assurance Officer, Aircraft Intermediate Maintenance Department (AIMD), Naval Air Station, Lemoore, CA, to collect information from the NALDA system. The author was interested in obtaining condensed, user friendly information relating to maintenance actions on the components discussed in the NTRs being analyzed. ENS Kirk directed the author to AZ1 Gilman, AIMD Data Analyst, who produced several Equipment Condition Analysis (ECA) reports for the author from the NALDA system.

ECA reports offer excellent insight down to the component level of all maintenance actions performed during the periods of interest for each item being analyzed. The author searched specific reports to segregate maintenance actions by month, to establish a trend of reliability/maintainability information specifically related to the item of interest.

1. ECA Report Number 0500

Known as the Period Monitoring Program Report, ECA "0500" (see Figure 4.2) is a highly flexible analytical tool. The report produces trend analysis data on a period-by-period basis covering a twelve period span. A description of the column headings follows.

- "SUBTOTAL ELEMENTS" - This column identifies the WUC of the item of interest for the trend analysis being conducted.

- "PERIOD" - Lists twelve periods as defined by the analyst for use in producing trend analysis data.

- "Total" - This is a summation of the numeric data provided in the twelve period columns.

2. ECA Report Number 0530

Known as the Detailed Maintenance Action Record Report, the ECA "0530" (see Figure 4.3) is a detailed description of the results of particular maintenance action. This description includes qualitative and quantitative data elements. A description of the column headings is provided below. Examples of specific codes are shown in Figure 4.4.

- "TYPE EQPT CODE" - Type Equipment Code (TEC). A TEC is assigned to every type, model and series aircraft, to every engine configuration and type of support equipment. The SH-3H aircraft, for instance, has a TEC of AHCM.

- "BUREAU SERIAL NUMBER" (BUNO) - The BUNO is used to identify individual airframes within the naval aircraft inventory. Each number is unique to a particular airframe.

- "WORK UNIT CODE" (WUC) - The WUC identifies the system, subsystem, and component or part of an aircraft, engine, or item of support equipment.

- "PI" - Position Indicator. Identifies the position of the installed engine, port or starboard.

- "Part Number" - A number used to identify an item of production or a range of items of production, by the manufacturer controlling the design, characteristics, and production of the item.

- "MFG CODE" - Manufacturers Code. A number assigned to manufacturers of items procured by agencies of the federal government.

- "SERIAL NBR" - Serial Number A unique number assigned to each part numbered repairable system, subsystem, and component or part of an aircraft, engine, or item of support equipment "JCN" - Job Control Number. A unique number consisting of the Organization Code (ORG), Julian Date (DATE), Sequence Number (SEQ) and suffix (SUF). The ORG code is a structured code that identifies activities within a major command. The Julian Date is the date the maintenance action originated. The SEQ code is a code that is assigned at the time the maintenance action originated. The SUF code is a code that identifies the maintenance action of a subsystem, component, or part to the original maintenance action on system.

- "MC" - Meter Code. Identifies the baseline time standard the component uses to accumulate operating time. Examples are "A" for aircraft time, and "M" for meter time.

- "METER TIME" - Identifies the number of operating hours since new.

- "TM" - Type Maintenance code. This is a code that identifies the type of maintenance performed.

- "WD" - When Discovered code. A code that identifies when the maintenance discrepancy was discovered.

- "ML" - Maintenance Level code. Maintenance tasks are divided into three levels so common standards can be applied to the many and varied aircraft maintenance activities of the military. The three levels are depot (D-), intermediate (I-), and organizational (O-).

- "ACT ORG" - Action Organization code. This is the same as the ORG code, but identifies which activity performed the last maintenance action for a specific JCN.

- "ACT DATE" - Action Date. This is the julian date at which the maintenance action is completed.

- "AT" - Action Taken code. A code that describes what action has been accomplished on the item identified by a WUC.

- "MAL CODE" - Malfunction Code. A code used to describe the malfunction occurring on or in an item identified by a WUC.

```
REPORT NBR:  R0500                              EQUIPMENT CONDITION ANALYSIS                                PAGE    1
PREPARED:    21 APR 1995
                                                 PERIOD MONITORING PROGRAM
T/M:  H3
ELEMENT MONITORED:  O LVL MHRS                 REPORT PERIOD:  SEP 87 THRU AUG 88
 SUBTOTALED BY (1) WUC                            LENGTH OF EACH PERIOD: 1 MONTH
              BY (2)
                BY (3)
```

SUBTOTAL ELEMENTS	PERIOD 1ST	2ND	3RD	4TH	5TH	6TH	7TH	8TH	9[illegible]	10TH	11TH	12TH	TOTAL
7511A11	41.20	22.70	28.80	31.40	36.20	17.50	26.10	29.30	6[illegible]0	20.20	32.50	9.70	357.90
COMBINED PERIOD INFORMATION:	41.20	22.70	28.80	31.40	36.20	17.50	26.10	29.30	6[illegible]0	20.20	32.50	9.70	357.90

Figure 4.2. Sample ECA Report Number 0500

```
REPORT NBR:  R0530                          EQUIPMENT CONDITION ANALYSIS                                    PAGE    1
PREPARED:    21 APR 1995
                                          DETAILED MAINTENANCE ACTION RECORD
                                           REPORT PERIOD:  SEP 87 THRU AUG 88
T/M:  H3
---------------------- EQUIPMENT ----------------------*---------------------- MAINTENANCE ACTION/DESCRIPTION ------------------
                                                       *                                                              CT 1
TYPE BUREAU  WORK                                      *                                           EMT   MAINT   OY C  DRCT
EQPT SERIAL  UNIT                       MFG            *------ JCN ------   M METER T W M ACT ACT    A MAL   OR    MAN-    RP C  MATL C
CODE NUMBER  CODE    PI    PART NUMBER  CODE  SERIAL NBR ORG DATE  SEQ SUF  C TIME  M D L ORG DATE   T CODE  DAY   HOURS   RE C  COST C

AHCM 149725 751LA11                                      AP1 87245 455              D L 1 AP1 87245 Z 170   0.3    0.3
AHCM 152134 751LA11                                      AH1 87250 485              B D 1 AH1 87250 C 306   2.5    2.5
AHCM 148039 751LA11     DL1020M259     12511 K0946       AR1 87253 108      A 1076  B D 1 AR1 87274 R 670   4.3    8.6               E
                        DL1020M259     12511 C0232                          A 1076                                                 G
AHCM 148039 751LA11     DL1020M259     12511 F0890       AR1 87253 183      A 1073  B H 1 AR1 87274 R 070   1.0    2.0               E
                        DL1020M259     12511 C0533                          A 1073                                                 G
                        DL1020M259     12511 E0629                          A 1073      2 A9C 87267 Z 170   6.7    6.7               F
AHCM 148039 751LA11     DL1020M259     12511 E0729       AR1 87253 184      A 1073  B H 1 AR1 87274 R 070   1.8    5.5               E
                        DL1020M259     12511 H010                           A 1073                                                 G
                                                                                    2 A9C 87271 Z 170   5.0    8.1
AHCM 148039 751LA11     DL1020M259     12511 F0372       AR1 87253 185      A 1073  B H 1 AR1 87274 R 070   2.1    4.2               E
                        DL1020M259     12511 C0585                          A 1073                                                 G
                        DL1020M259     12511 J0623                          A 0733      2 A9C 87267 C 374   4.7    4.7               E
                 FAILED PARTS ASSOCIATED                   REF    MFG   A  MAL      M      DATE   REQ  DATE
                 WITH THE ABOVE ARE:        PART NUMBER  SYMBOL  CODE   T  CODE QTY L PRI ORD     NBR  RCVD

                                       M108M2                    12511 R  374   01 2

AHCM 148039 751LA11     DL1020M259     12511 P0212       AR1 87258 108      A 0733  B H 2 A9C 87266 A 799   1.3    1.3               F
AHCM 149724 751LA11                                      PM3 87259 037              B D 1 PM3 87273 C 135   0.5    0.5
AHCM 149724 751LA11                                      PM3 87259 051              B D 1 PM3 87273 C 135   0.5    0.5
AHCM 149904 751LA11     DL1020M259     12511 J0819       PQ3 87260 345      A 0363  B H 1 PQ3 87260 R 780   3.0    3.0               E
                        DL1020M259     12511 F0832                          A 0369                                                 G
                                                                                    2 D98 87260 Z 160   2.0    2.0
AHCM 149931 751LA11                                      PL3 87262 575              B B 1 PL3 87262 B 070   1.0    1.0
AHCM 148039 751LA11     DL1020M259     12511 125102      AR1 87263 108      A 1073  B H 1 AR1 87266 R 070   2.4    4.8               E
                        DL1020M259     12511 F0436                          A 1073                                                 G
AHCM 144039 751LA11     DL1020M259     12511 C0533       AR1 87266 188      A 1073  B H 1 AR1 87273 N 525   1.6    1.6               E
                                                                                    2 A9C 87267 C 780   3.3    3.3
AHCM 148039 751LA11     DL1020M259     12511 K0712       AR1 87266 189      A 1073  B H 1 AR1 87273 N 525   2.0    2.0               E
                                                                                    2 A9C 87267 C 374   2.8    2.8
                 FAILED PARTS ASSOCIATED                   REF    MFG   A  MAL      M      DATE   REQ  DATE
                 WITH THE ABOVE ARE:        PART NUMBER  SYMBOL  CODE   T  CODE QTY L PRI ORD     NBR  RCVD

                                       M108M2                    12511 R  374   01 2

AHCM 148039 751LA11     DL102DM259     12511 G0585       AR1 87266 190      A 1073  B H 1 AR1 87273 N 525   1.6    1.6               E
                                                                                    2 A9C 87266 A 799   1.3    1.3
AHCM 148039 751LA11     DL1020M259     72511 E0636       AR1 87266 191      A 1073  B H 1 AR1 87273 N 525   1.6    1.6               F
```

Figure 4.3. Sample ECA Report Number 0530

- "EMT OR DAY" - Elapsed Maintenance Time or Day. Identifies the length of time maintenance was being performed on the item identified by a WUC. This time is not cumulative for more than one person working on the item at the same time."MAINT MAN-HOURS" - Maintenance Man-Hours. This is the cumulative length of time maintenance was being performed on the item identified by a WUC. It includes the time all personnel are working on the same item

- "CT OY RP RE" - Corrosion Type. For future use. Undefined for the current version of NALDA.

- "ICC" - Incoming Condition Correction Code. For future use. Undefined for the current version of NALDA.

- "DRCT MATL COST" - Direct Material Cost. For future use. Undefined for the current version of NALDA.

- "CC" - Card Code. For future use. Undefined for the current version of NALDA.

Type Maintenance Codes:
B. Used to document an Unscheduled Maintenance action
D. Used to document Scheduled Inspections
E. Used to document Acceptance and Transfer Inspections
G. Used to document a Phase Inspection
J. Used to document Major Engine Inspections (MEIs)
K. Used to document special engine inspections
T. Used to document a work request received from supply

When Discovered Code:
A. Found by the aircrew, before the flight, caused the flight to be aborted
B. Found by the aircrew, before flight, but did not cause an abort
C. Found by the aircrew in flight, caused the flight to be aborted
D. Found by the aircrew in flight, but did not cause an abort
H. Found by the ground maintenance crews between flights
K. Found during Preflight, Daily, Postflight or Turnaround inspection
L. Found during a special inspection
M. Found during major/phase inspection
O. Used when an administrative action is required
R. Found during a quality assurance inspection
V. Found when another work center is required

Action Taken Codes:
A. Used to document instances where either the component or system inspected is within tolerances, or that the stated discrepancy could not be duplicated.
B. Used to document repair or replacement of consumable items that are not work unitl coded.
C. Used to document cleaning, disassembly, inspection, reassemply, lubrication, replacement of integral parts and adjustments.
R. Used to document the removal of an item due to a suspected malfunction and the reinstallation of the same or similar item.
S. Used to document the removal and installation of the same item in order to facilitate other maintenance.
T. Used to document the cannibalization of an item.
Z. Used to document corrosion treatment.
Codes 1-8 are used to document when a component is beyone the capability of I-Level Maintenance (BCM), and shipped to the D-level for repair.

Malfunction Codes:

000	Inspection Code	295	Fails check/test	799	No Defect, Malfunction could not be duplicated
020	Worn, Stripped Chafed, Frayed	314	Acceleration/ Decelleration improper	807	No Defect, Removed/ Installed directed by Higher Authority
051	Fails to tune/drifts	374	Internal failure	813	Cannibalized; Directed by Higher Authority
070	Broken, Burst	383	Lock-on malfunction	814	Cannibalized due to lack of replacement parts or spares
127	Misaligned	525	Incorrect Pressure	900	Burned or overheated
135	Binding, Jammed	599	Travel or extension incorrect	932	Does not engage, lock or unlock properly
160	Broken wires, defective contact or connection	602	Failed due to Assoc. Equipment		
169	Voltage incorrect	615	Shorted		
170	Corroded	780	Bent, buckled, dented		
255	No output				

Figure 4.4. Sample Maintenance Data Codes

C. RESEARCH MODEL

The author chose a period of time ranging from one year prior to and one year after the NTR was written. Data fields from ECA reports which were of particular interest for analysis are listed below.

- Work Unit Code: Used to sort the data of interest from the NALDA system to a particular aircraft and system.
- Part Number: Used to further segregate the maintenance data because the Work Unit Code may apply to several other part numbered items as well.
- Maintenance Level: Used to further differentiate between those maintenance actions performed at the Organizational (O-) and Intermediate (I-) levels of maintenance.
- Action Taken Code: Used to determine valid failures, excluding those maintenance actions that are administrative in nature or were not a type of repair action.
- Malfunction Description Code: Also used to exclude those maintenance actions that are administrative in nature or were not a type of repair action as well.
- Maintenance Man-Hours: Used to quantify the time spent on specific maintenance actions.

The author requested "0500" reports with specific parameters to establish a trend during the period of interest for which each item addressed in the NTRs was analyzed. Parameters included verified fails, O-level manhours, and I-level manhours over 12-month time periods. The purpose behind use of verified fails to attempt to establish a trend of true failures associated with each item. Any indication of reduced numbers of failures would signal a direct benefit from the NTR on the reliability of the item. More simply stated, the fewer failures over a specific period correlates to fewer maintenance actions which defines the term reliability.

Additionally, the author was interested in the number of maintenance manhours at both O-level and I-level maintenance activities associated with corrective maintenance on a failed item. Any indication of reduced numbers of manhours expended per failed item would signal a direct benefit from the NTR on the maintainability of the item. Again, more simply stated, the fewer manhours required to repair failed items correlates to less time spent in direct maintenance activities. Overall, this defines the term maintainability. From the number of failures and maintenance manhours, and O-level and I-level wage rates [Ref.], the author could determine the average O-level and I-level maintenance manhour per failure, total labor costs for each period of time, and could forecast the future labor costs of maintaining the item. Using this information, the author would be able to conclude if there indeed was a cost savings realized through improved reliability and maintainability.

The next step was to determine material/depot repair costs for equipment failures. First of all, the author assumed the costs for bit and piece repair materials used in I-level repair was negligible, so they were not included in the model for study. The author requested "0530" reports with specific parameters to analyze each maintenance action performed on the items of interest. Parameters included type aircraft, WUC, and period of interest. The purpose behind this was to determine the number of items that were not being repaired but were being returned to the D-level for repair because it was beyond the capability of maintenance (BCM) at O- and I-level maintenance activities. This could be determined by counting the number of maintenance actions with a numeric "Action Taken" code (see Figure 4.4). Any indication of reduced BCM actions would signal a direct benefit from the NTR on the maintainability of the item. From this, the author could determine the average number of BCMs, and, using current depot repair cost data, could forecast the future costs of maintaining the item from a material cost viewpoint. Using this information, the author could evaluate cost savings realized through improved maintainability.

After collecting data from all relevant sources, the author constructed a spreadsheet for each NTR of interest. Chapter V presents these spreadsheets as well as a discussion of

each NTR and its related feedback report. Also included is a graphic representation of the trends of the maintenance data from a period one year prior to the NTR to one year after. Finally, the author presents an analysis of each.

V. NAESU TECHNICAL REPORT ANALYSIS

A. NTR SERIAL NUMBER 9388/02

Report Date: 20 April 1994

Author: Christopher Pinkava

Activity: NAESU Detachment Barbers Point, Hawaii

Discussion: The AN/ARN-140 Navigation Receiver is a VOR, localizer glideslope and marker beacon receiver used by P-3C aircraft to provide VOR bearing, course deviation, to-from, glideslope deviation, and marker beacon lamp information to allow enroute air navigation and instrument landing. At the time of this report, there were no Ready-For-Issue (RFI) AN/ARN-140 receivers available in the supply system. The previous method of depot repair by a civilian contractor was not efficient and caused depletion of these much needed fleet assets. This report addressed this shortage and proposed a cost effective modification to an obsolete test bench that would establish in-house maintenance capability for the Navy at the Intermediate Level. Upon review of this report, the CFA approved the modification of the test bench and the proposed procedures for repair by the Aircraft Intermediate Maintenance Departments (AIMDs) at Naval Air Stations Barbers Point, Hawaii, and Brunswick, Maine. [Ref. 19 and 20]

Analysis: Initial review of maintenance data (see Figure 5.1) before and after the NTR was submitted did not reveal a trend of reduced equipment failures or reduced maintenance manhours at either the O- or I-level activities. Failures remained at an average of 3.3 per month (Figure 5.2), O-level maintenance manhours averaged 33.4 per month, while the number of I-level maintenance manhours remained at zero until repair actions started in June, 1994 (Figure 5.3). The number of BCMs averaged 1.25 per month even after AIMD Barbers Point received conditional approval for full repair capability. Total repair costs

remained relatively constant throughout the period of interest (Figure 5.4). Based upon the maintenance data, the author could show no appreciable cost savings which could be attributed to the NTR.

Continuing investigation through the Commander, Patrol Wings, Pacific logistics office provided further insight into the results of this NTR. The author interviewed Mr. Jack Cargal [Ref. 21], who related how the Aviation Supply Office (ASO) item manager shipped 54 failed items to AIMD Barbers Point for repair and return to stock. This was done outside the normal maintenance documentation procedures, so would not be shown upon maintenance data reports. With this in mind, the author calculated the savings from this single action, AIMD had saved the Department of the Navy over $67,000 in the first year alone by avoiding depot repair costs of $1,252 per unit. The author interviewed Mr. Chuck Terlizzi [Ref. 22], the item manager at ASO, who stated the average demand, which relates directly to the failure rate, of the item was forecasted as seven per quarter. With this information, the author calculated the cost savings until the year 2002 (see Figures 5.5 and 5.6).

Based upon the full information concerning this item, the cost savings attributable to the maintenance level change amounts to over $67,000 annually from a modification that only cost $400.

Nomen: AN/ARN-140 Navigation Receiver
NIIN: 01-136-7886
Period: Jan93 - Dec94

Aircraft: P3
Item Cost: $8,910 00
Repair Cost $2,213 00

Month	Verified Fails	"O" LVL MH	"I" LVL MH	Total MH	"O" LVL Costs	"I" LVL Costs	Total Labor Costs	BCMs	Depot Repair Costs	Total Costs
JAN	6	56.2	0	56.2	$959.90	$0.00	$959.90	2	$4,426.00	$5,385.90
FEB	6	107.4	0	107.4	$1,834.39	$0.00	$1,834.39	1	$2,213.00	$4,047.39
MAR	2	24.3	0	24.3	$415.04	$0.00	$415.04	0	$0.00	$415.04
APR	5	23.3	0	23.3	$397.96	$0.00	$397.96	3	$6,639.00	$7,036.96
MAY	3	45.5	0	45.5	$777.14	$0.00	$777.14	2	$4,426.00	$5,203.14
JUN	0	3.6	0	3.6	$61.49	$0.00	$61.49	0	$0.00	$61.49
JUL	2	15.6	0	15.6	$266.45	$0.00	$266.45	2	$4,426.00	$4,692.45
AUG	1	13.2	0	13.2	$225.46	$0.00	$225.46	1	$2,213.00	$2,438.46
SEP	2	21.8	0	21.8	$372.34	$0.00	$372.34	2	$4,426.00	$4,798.34
OCT	6	49.4	0	49.4	$843.75	$0.00	$843.75	1	$2,213.00	$3,056.75
NOV	3	27	0	27	$461.16	$0.00	$461.16	1	$2,213.00	$2,674.16
DEC	1	15.4	0	15.4	$263.03	$0.00	$263.03	0	$0.00	$263.03
JAN	5	131.1	0	131.1	$2,375.53	$0.00	$2,375.53	0	$0.00	$2,375.53
FEB	3	14.9	19.8	34.7	$269.99	$406.10	$676.09	1	$2,213.00	$2,889.09
MAR	4	51.1	0	51.1	$925.93	$0.00	$925.93	2	$4,426.00	$5,351.93
APR	4	30.3	0	30.3	$549.04	$0.00	$549.04	2	$4,426.00	$4,975.04
MAY	3	11.1	0	11.1	$201.13	$0.00	$201.13	1	$2,213.00	$2,414.13
JUN	3	14.6	14.5	29.1	$264.55	$297.40	$561.95	2	$4,426.00	$4,987.95
JUL	4	40.8	12.6	53.4	$739.30	$258.43	$997.72	1	$2,213.00	$3,210.72
AUG	6	53.1	81.4	134.5	$962.17	$1,669.51	$2,631.69	3	$6,639.00	$9,270.69
SEP	2	26.8	198.4	225.2	$485.62	$4,069.18	$4,554.80	0	$0.00	$4,554.80
OCT	5	10.5	0	10.5	$190.26	$0.00	$190.26	2	$4,426.00	$4,616.26
NOV	2	9.2	0	9.2	$166.70	$0.00	$166.70	0	$0.00	$166.70
DEC	1	6	0.6	6.6	$108.72	$12.31	$121.03	1	$2,213.00	$2,334.03

Figure 5 1 NTR Serial Number 9388/02 Maintenance Data

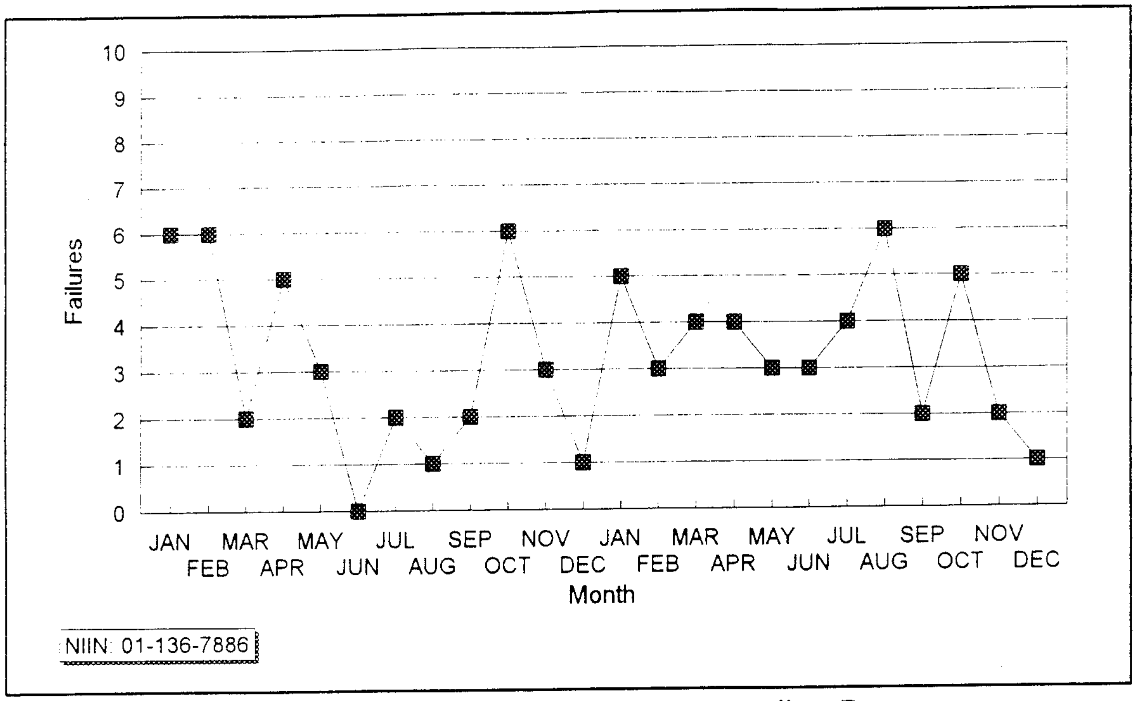

Figure 5.2. NTR Serial Number 9388/02 Failure Data

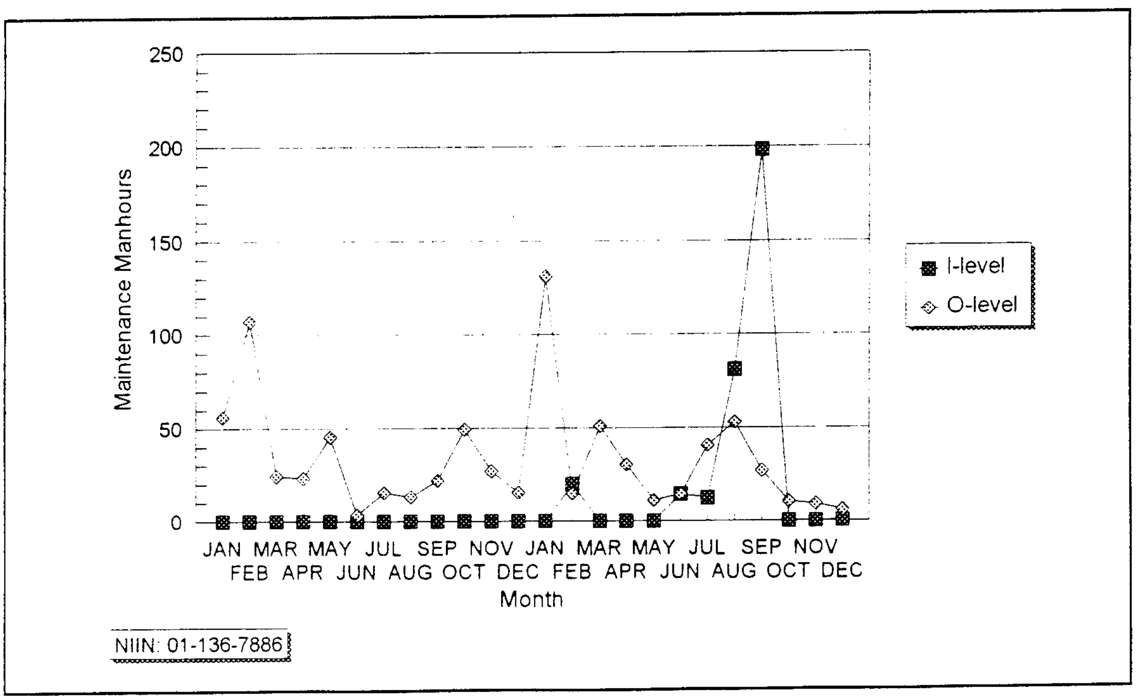

Figure 5.3. NTR Serial Number 9388/02 Maintenance Manhour Data

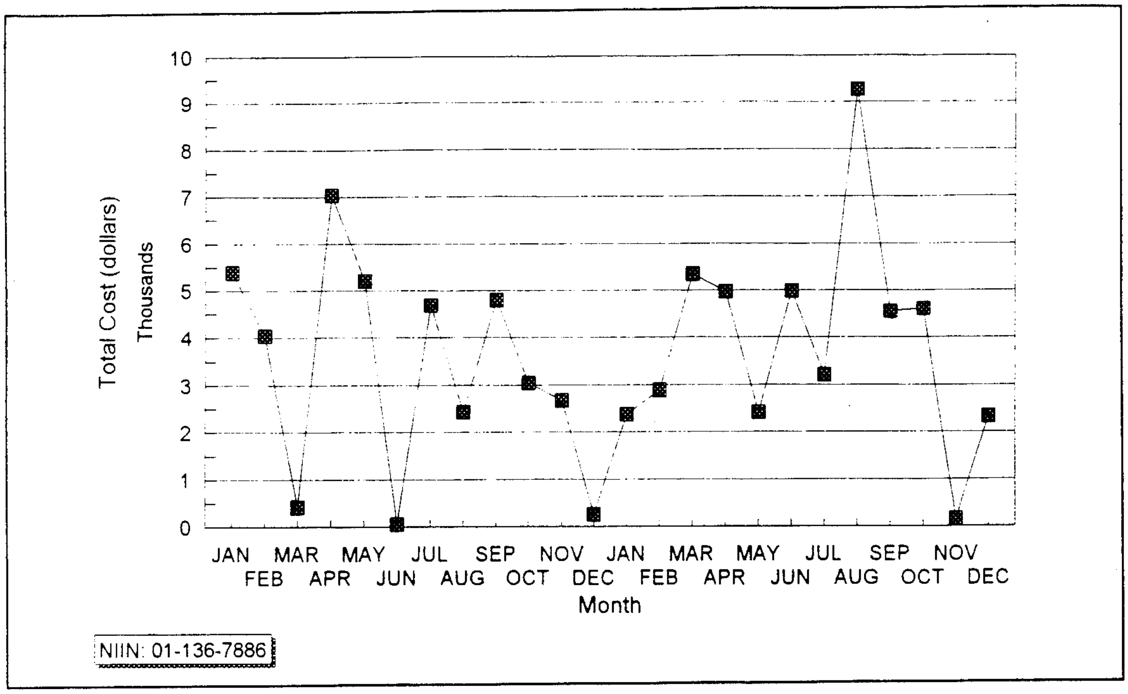

Figure 5.4. NTR Serial Number 9388/02 Maintenance Cost Data

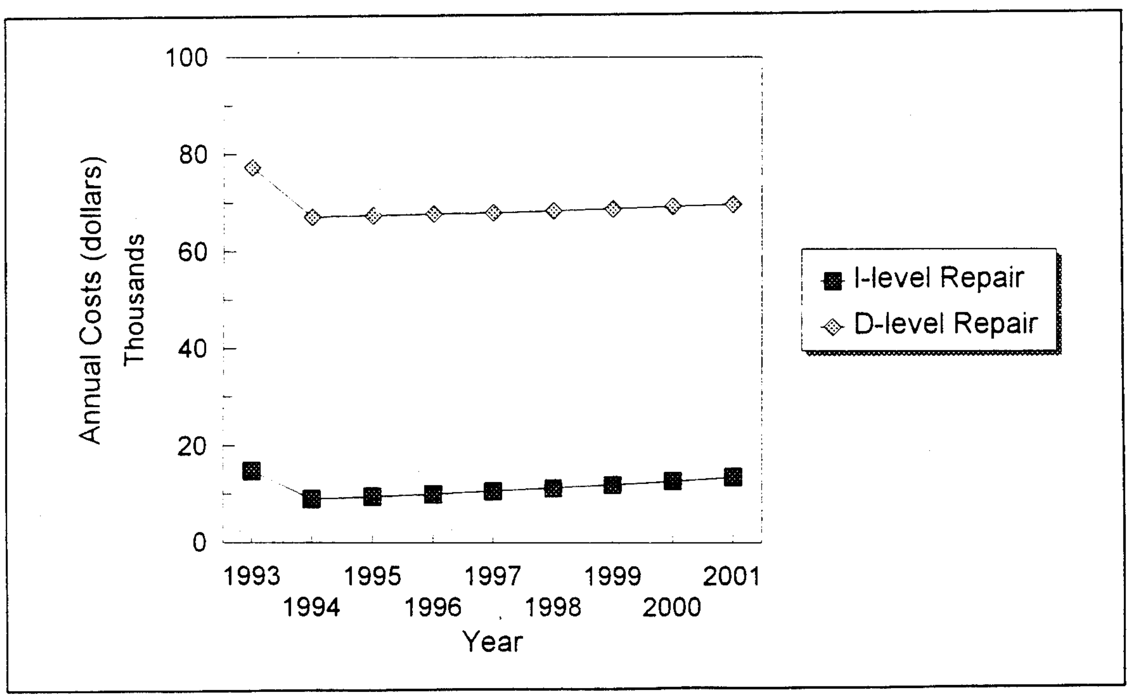

Figure 5.5. I-level versus D-level Repair Costs

YEAR	O-LEVEL MAINT. ACTIONS	I-LEVEL MAINT. ACTIONS	D-LEVEL MAINT. ACTIONS	O-LEVEL MAINT. MAN-HOURS	I-LEVEL MAINT. MAN-HOURS	O-LEVEL MMH LABOR COST/HOUR	I-LEVEL MMH LABOR COST/HOUR
1993	37	0	32	402.70	0.00	$17.08	$20.51
1994	42	56	0	399.50	327.30	$18.12	$21.74
1995	28	28	0	266.33	163.65	$19.22	$23.06
1996	28	28	0	266.33	163.65	$20.39	$24.47
1997	28	28	0	266.33	163.65	$21.63	$25.96
1998	28	28	0	266.33	163.65	$22.94	$27.54
1999	28	28	0	266.33	163.65	$24.33	$29.21
2000	28	28	0	266.33	163.65	$25.81	$30.99
2001	28	28	0	266.33	163.65	$27.38	$32.88
2002	28	28	0	266.33	163.65	$29.05	34.89

YEAR	DEPOT REPAIR COST/REPAI	O-LEVEL MAINT. LABOR COST	I-LEVEL MAINT. LABOR COST	TOTAL MAINT. LABOR COST	TOTAL DEPOT REPAIR COST	INVESTMENT COST	TOTAL COST MAINT. (WITH I-LEV REPAIR)	TOTAL COST MAINT. (WITH D-LEVE REPAIR)
1993	$1,252.00	$6,878.12	$0.00	$6,878.12	$40,064.00	$400.00	$47,342.12	$47,342.12
1994	$1,252.00	$7,238.94	$7,115.50	$14,354.44	$0.00	$400.00	$14,754.44	$77,350.94
1995	$2,213.00	$5,118.93	$3,773.77	$8,892.70	$0.00	$0.00	$8,892.70	$67,082.93
1996	$2,213.00	$5,430.54	$4,004.52	$9,435.05	$0.00	$0.00	$9,435.05	$67,394.54
1997	$2,213.00	$5,760.79	$4,248.35	$10,009.14	$0.00	$0.00	$10,009.14	$67,724.79
1998	$2,213.00	$6,109.69	$4,506.92	$10,616.61	$0.00	$0.00	$10,616.61	$68,073.69
1999	$2,213.00	$6,479.89	$4,780.22	$11,260.11	$0.00	$0.00	$11,260.11	$68,443.89
2000	$2,213.00	$6,874.06	$5,071.51	$11,945.58	$0.00	$0.00	$11,945.58	$68,838.06
2001	$2,213.00	$7,292.21	$5,380.81	$12,673.02	$0.00	$0.00	$12,673.02	$69,256.21
2002	$2,213.00	$7,736.98	$5,709.75	$13,446.73	$0.00	$0.00	$13,446.73	$69,700.98

Figure 5.6. NTR Serial Number 9388/02 Repair Cost Analysis Data

B. NTR SERIAL NUMBER 8672/15

Report Date: 26 January 1987

Author: Duane P. Healy

Activity: NAESU Detachment Jacksonville, Florida

Discussion: The battery absorber used in the H-3 aircraft is designed to counteract the five per revolution vibrations caused by the main rotor blades. When parts get worn or when the battery absorber is improperly adjusted, it will accentuate these vibrations. A sudden rash of vibration problems revealed the link assemblies, part number S6120-61002-6, are being received from supply in an unusable condition. It appears the bearings are being pressed into the link improperly, causing bearing pre-load and subsequent binding action in the bearings. This report requested the CFA review the manufacturing specifications with the contractor to ensure link assemblies were being produced. Subsequent investigation by the CFA revealed the need for a spacer to be inserted between the bearings, thus preventing pre-loading of the inner races when the bearings are pressed into the bracket of the link assembly. [Refs. 23 and 24]

Analysis: Initial review of maintenance data (see Figure 5.7) before and after the NTR was submitted revealed a trend of reduced equipment failures and reduced maintenance manhours at the O-level activities (Figures 5.8 and 5.9). I-level maintenance manhours are not included in this analysis, as the item is not an I-level repairable. Failures remained at an average of 2.6 per month through July and then dropped off to nearly zero. O-level maintenance manhours followed the same trend, dropping off during May. Total cost data shows a downward trend. Due to the low unit cost of the item, the cost savings is not dramatic (Figure 5.10). Based upon the maintenance data, the author determined only minor cost savings which could be attributed to improved reliability and maintainability from the NTR.

Nomen:	Support, Structural Component	**Aircraft:**	H3
NIIN:	00-822-3993	**Item Cost:**	$42.59
Period:	Jan86 - Dec87	**Repair Cost:**	N/A

Month	Verified Fails	"O" LVL MH	"I" LVL MH	Total MH	"O" LVL Costs	"I" LVL Costs	Total Labor Costs	Total Material Costs	Total Costs
JAN	2	8.3	0	8.3	$141.76	$0.00	$141.76	$85.18	$226.94
FEB	1	2	0	2	$34.16	$0.00	$34.16	$42.59	$76.75
MAR	3	13	0	13	$222.04	$0.00	$222.04	$127.77	$349.81
APR	2	29.6	0	29.6	$505.57	$0.00	$505.57	$85.18	$590.75
MAY	5	50.3	0	50.3	$859.12	$0.00	$859.12	$212.95	$1,072.07
JUN	2	14.5	0	14.5	$247.66	$0.00	$247.66	$85.18	$332.84
JUL	4	16.2	0	16.2	$276.70	$0.00	$276.70	$170.36	$447.06
AUG	3	26.8	0	26.8	$457.74	$0.00	$457.74	$127.77	$585.51
SEP	5	32.7	0	32.7	$558.52	$0.00	$558.52	$212.95	$771.47
OCT	4	32.4	0	32.4	$553.39	$0.00	$553.39	$170.36	$723.75
NOV	3	11.7	0	11.7	$199.84	$0.00	$199.84	$127.77	$327.61
DEC	2	39.2	0	39.2	$669.54	$0.00	$669.54	$85.18	$754.72
JAN	3	17.3	0	17.3	$313.48	$0.00	$313.48	$127.77	$441.25
FEB	4	29.2	0	29.2	$529.10	$0.00	$529.10	$170.36	$699.46
MAR	3	32.7	0	32.7	$592.52	$0.00	$592.52	$127.77	$720.29
APR	2	33.1	0	33.1	$599.77	$0.00	$599.77	$85.18	$684.95
MAY	2	7	0	7	$126.84	$0.00	$126.84	$85.18	$212.02
JUN	4	16.9	0	16.9	$306.23	$0.00	$306.23	$170.36	$476.59
JUL	4	14	0	14	$253.68	$0.00	$253.68	$170.36	$424.04
AUG	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00
SEP	1	4.2	0	4.2	$76.10	$0.00	$76.10	$42.59	$118.69
OCT	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00
NOV	3	13.6	0	13.6	$246.43	$0.00	$246.43	$127.77	$374.20
DEC	1	17.7	0	17.7	$320.72	$0.00	$320.72	$42.59	$363.31

Figure 5.7. NTR Serial Number 8672/15 Maintenance Data

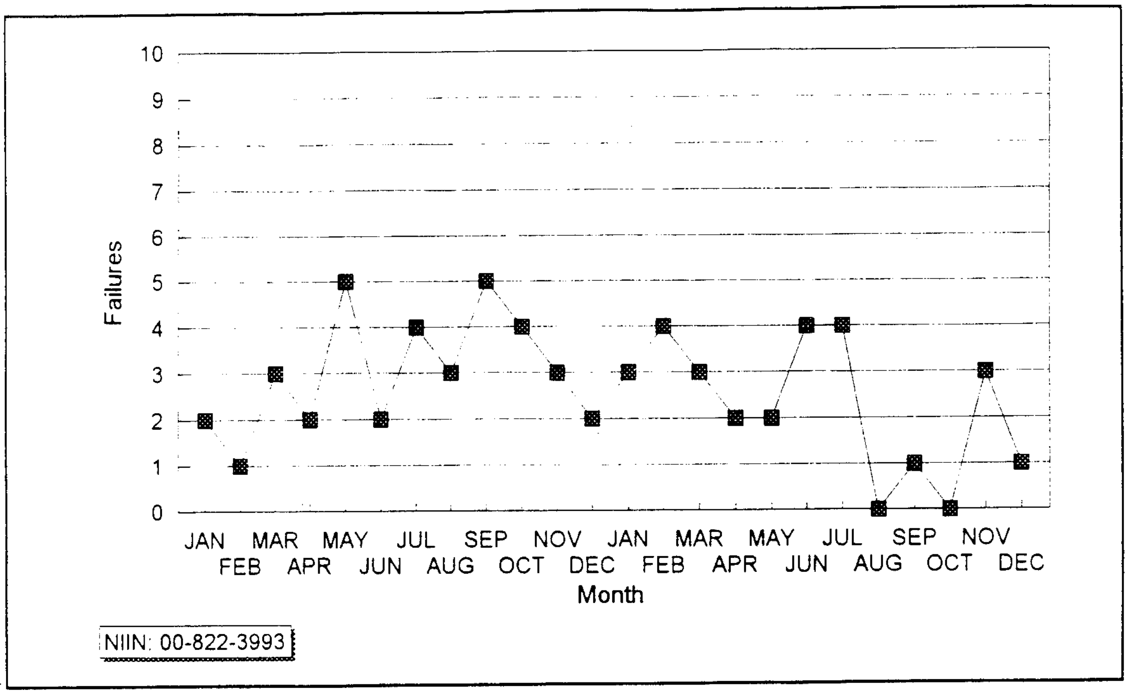

Figure 5.8. NTR Serial Number 8672/15 Failure Data

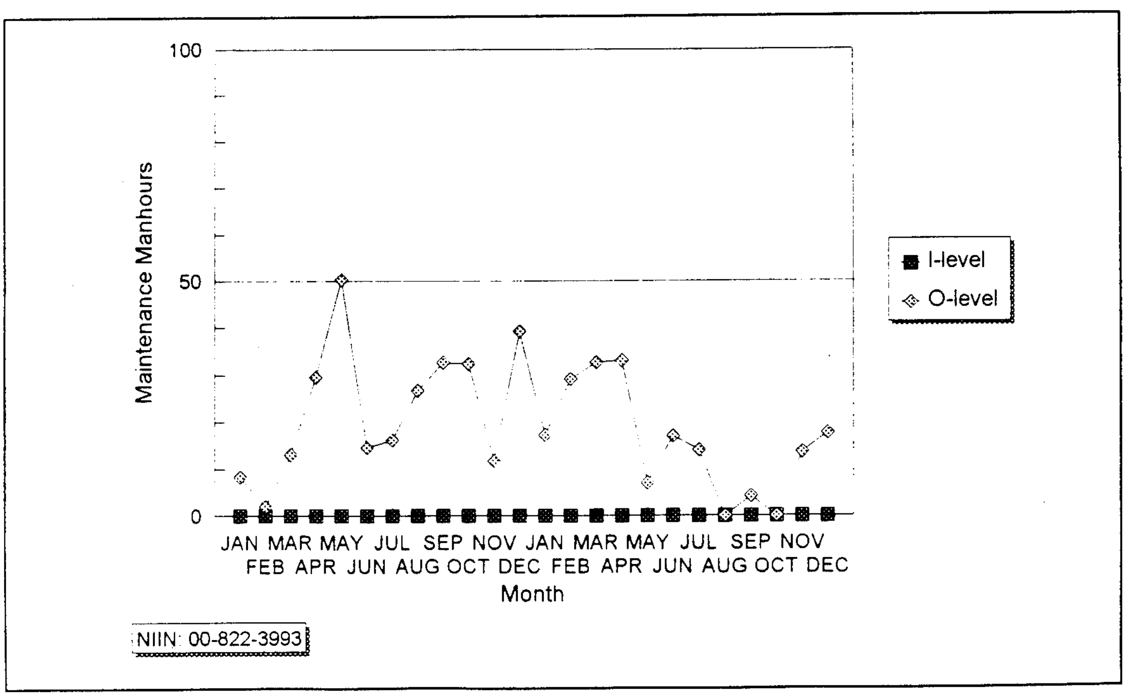

Figure 5.9. NTR Serial Number 8672/15 Maintenance Manhour Data

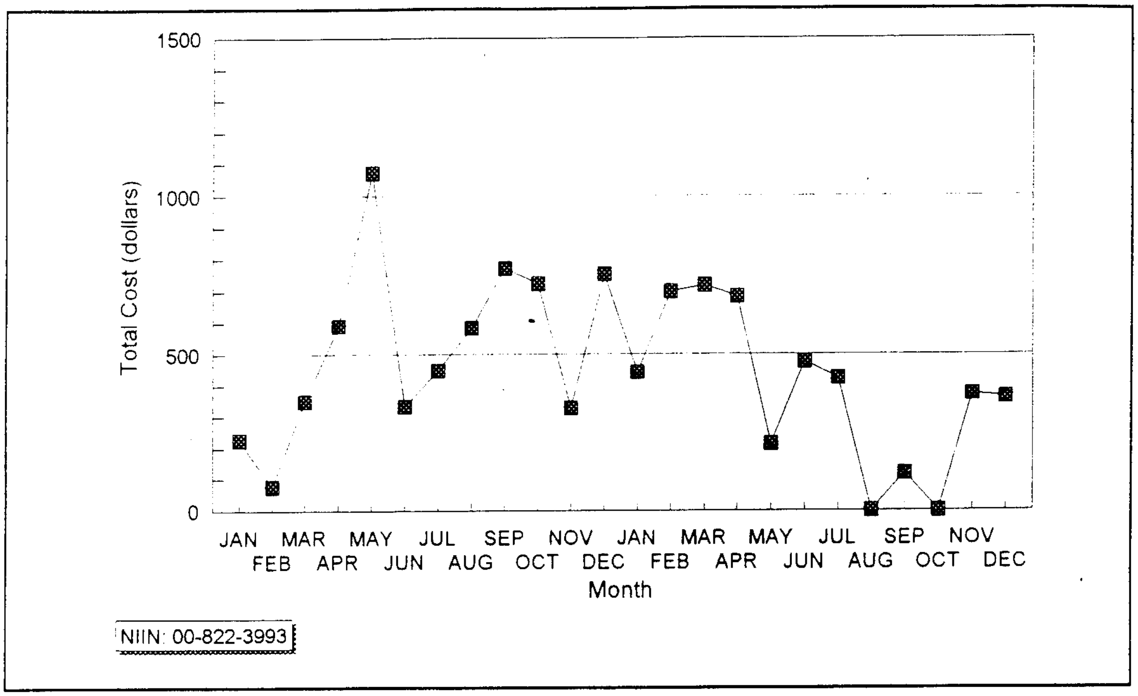

Figure 5.10. NTR Serial Number 8672/15 Cost Data

C. NTR SERIAL NUMBER 8629/09

Report Date: 29 August 1988

Author: Toney Herlevic

Activity: NAESU Detachment Miramar, California

Discussion: The APS-125 radar system in the E-2C aircraft provides a one mega watt transmit pulse to the APA-171 antenna system through a series of connected rigid coax transmission lines. One section of this line, designation W85, differs from the other sections in that it is adjustable. Failure to follow directions for proper installation of the rigid coax lines could result in damage and subsequent degradation of the radar and eventual total shutdown of the system. This report recommended the CFA insert a caution in the maintenance publication to prevent the damage found. The CFA agreed with the recommendation and submitted a manual change request to incorporate the suggested solution into the appropriate maintenance manual. [Refs. 25 and 26]

Analysis: Initial review of maintenance data (see Figure 5.11) before and after the NTR was submitted did not reveal a trend of reduced equipment failures or reduced maintenance manhours at the O- or I-level activities (Figures 5.12 and 5.13). Total cost data shows no significant trend (Figure 5.14). Based upon the maintenance data, the author could not attribute any improvements in reliability or maintainability, nor any related cost savings to the NTR.

Nomen: Line Section, Radio Frequency
NIIN: 00-097-3569
Period: Sep87 - Aug89

Aircraft: E2
Item Cost: $2,220.00
Repair Cost: $710.00

Month	Verified Fails	"O" LVL MH	"I" LVL MH	Total MH	"O" LVL Costs	"I" LVL Costs	Total Labor Costs	BCMs	Depot Repair Costs	Total Costs
SEP	0	0	0	0	$0.00	$0.00	$0.00	0	$0.00	$0.00
OCT	0	0	0	0	$0.00	$0.00	$0.00	0	$0.00	$0.00
NOV	0	0	0	0	$0.00	$0.00	$0.00	0	$0.00	$0.00
DEC	1	23.6	0	23.6	$403.09	$0.00	$403.09	0	$0.00	$403.09
JAN	0	21.4	0	21.4	$365.51	$0.00	$365.51	1	$710.00	$1,075.51
FEB	0	3.5	0	3.5	$59.78	$0.00	$59.78	0	$0.00	$59.78
MAR	0	0	0	0	$0.00	$0.00	$0.00	0	$0.00	$0.00
APR	0	0	0	0	$0.00	$0.00	$0.00	0	$0.00	$0.00
MAY	0	0	0	0	$0.00	$0.00	$0.00	0	$0.00	$0.00
JUN	0	0	0	0	$0.00	$0.00	$0.00	0	$0.00	$0.00
JUL	1	0.5	0	0.5	$8.54	$0.00	$8.54	0	$0.00	$8.54
AUG	0	0	0	0	$0.00	$0.00	$0.00	0	$0.00	$0.00
SEP	2	18.4	0	18.4	$333.41	$0.00	$333.41	1	$710.00	$1,043.41
OCT	1	2	0	2	$36.24	$0.00	$36.24	0	$0.00	$36.24
NOV	2	31.8	0	31.8	$576.22	$0.00	$576.22	0	$0.00	$576.22
DEC	0	0	0	0	$0.00	$0.00	$0.00	0	$0.00	$0.00
JAN	0	0	0	0	$0.00	$0.00	$0.00	0	$0.00	$0.00
FEB	0	0	0	0	$0.00	$0.00	$0.00	0	$0.00	$0.00
MAR	1	165.7	96.8	262.5	$3,002.48	$1,985.37	$4,987.85	1	$710.00	$5,697.85
APR	0	0	0	0	$0.00	$0.00	$0.00	0	$0.00	$0.00
MAY	0	0	0	0	$0.00	$0.00	$0.00	0	$0.00	$0.00
JUN	0	23	0	23	$416.76	$0.00	$416.76	1	$710.00	$1,126.76
JUL	3	79.4	0	79.4	$1,438.73	$0.00	$1,438.73	1	$710.00	$2,148.73
AUG	3	1.9	0	1.9	$34.43	$0.00	$34.43	0	$0.00	$34.43

Figure 5.11. NTR Serial Number 8629/09 Maintenance Data

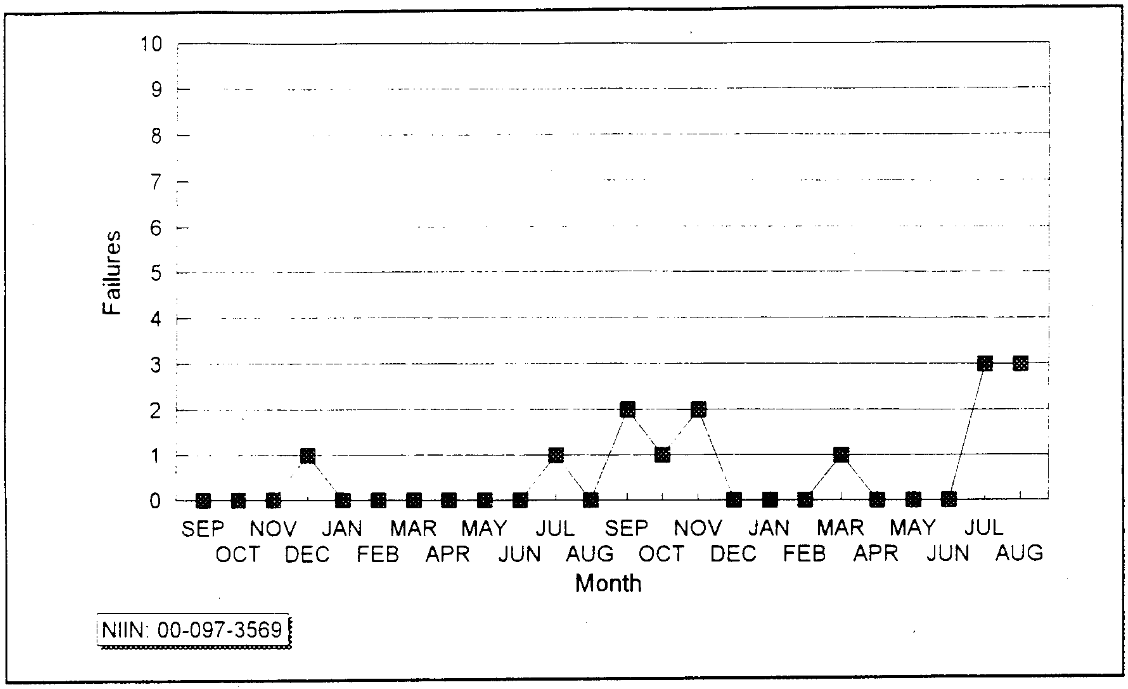

Figure 5.12. NTR Serial Number 8629/09 Failure Data

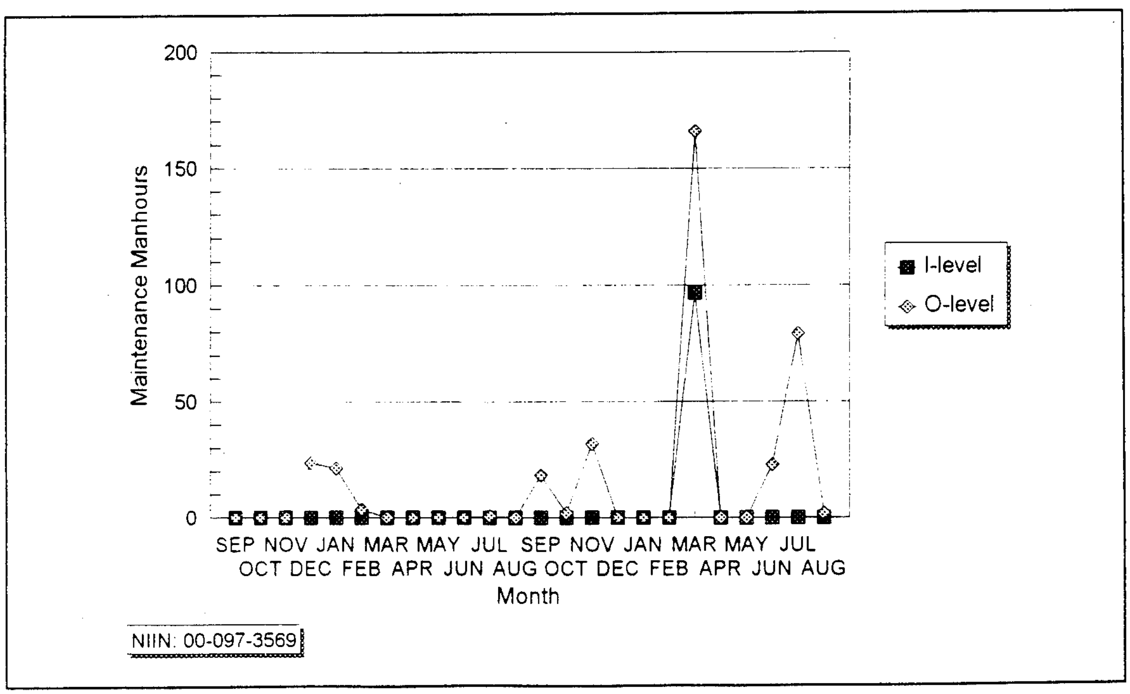

Figure 5.13. NTR Serial Number 8629/09 Maintenance Manhour Data

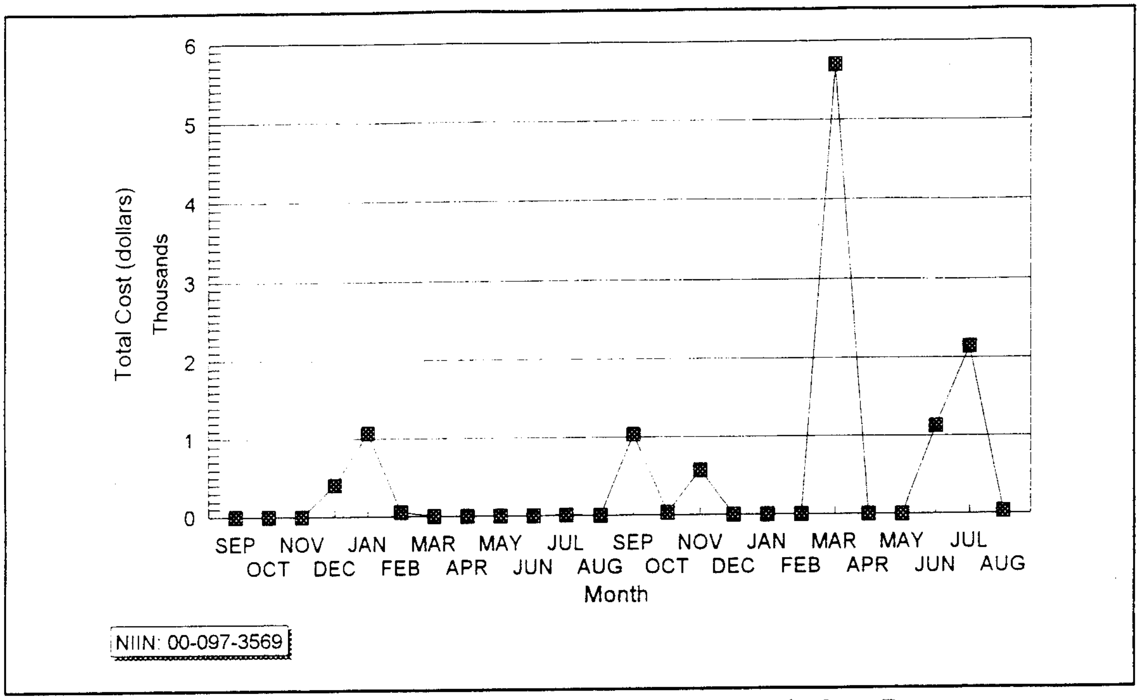

Figure 5.14. NTR Serial Number 8629/09 Repair Cost Data

D. NTR SERIAL NUMBER 9124/02

Report Date: 16 June 1987

Author: Leonard A. Kress

Activity: NAESU Detachment Jacksonville, Florida

Discussion: Numerous manhours had been expended troubleshooting defective APS-115 azimuth and tilt servo amplifiers on the P-3 aircraft. Many suspected bad parts were changed with no positive results. Investigation revealed that in all of the defective servo amplifiers, the T-1 transformer, part number 43871, had been replaced. Closer examination revealed internal connections in the replacement transformers were reversed during manufacture, resulting in no output and overheating. The report recommended reversal of the external connections and re-labeling output pins to correspond with the internal wiring change, and that steps be taken to ensure the transformers for the given part number be correctly manufactured in the future. [Refs. 27 and 28]

Analysis: Initial review of maintenance data (see Figure 5.15) before and after the NTR was submitted did not reveal a trend of reduced equipment failures or reduced maintenance manhours at I-level activities (Figures 5.16 and 5.17). O-level maintenance manhours are not included in this analysis, as the item is an I-level repairable. Total cost data shows no significant trend (Figure 5.18). Based upon the maintenance data, the author concluded there were no cost savings which could be attributed to improved reliability and maintainability from the NTR.

E. NTR SERIAL NUMBER 8821/06

Report Date: 11 December 1989

Author: John W. Lammers

Activity: NAESU Detachment Miramar, California

Discussion: The flight control backup module pressure operated priority valve, part number A51H9214-3, can be installed backwards in the combined hydraulic system of the F-14 aircraft. The hydraulic system will appear to function normally, yet the emergency flight control backup module will operate in a degraded mode with fluid bypass and system over-temperature discrepancies. Continued operation under these conditions could cause loss of aircrew and aircraft. The report strongly recommended the CFA: 1) issue a one-time inspection of all F-14 aircraft for proper installation; 2) ensure the graphics in the maintenance manual clearly indicates proper installation orientation; and 3) direct the aircraft intermediate maintenance department and supply ensure the data plate showing the direction of fluid flow is affixed to the valve. The CFA responded by issuing an airframes bulletin to all F-14 aircraft activities directing them to perform a one-time inspection to identify and correct the installation of the valves as necessary. [Refs. 29 and 30]

Analysis: Initial review of maintenance data (see Figure 5.19) before and after the NTR was submitted did not reveal any trends. Available data showed a minimal number of

repair actions at either the O- or I-level maintenance activities. Based upon the maintenance data, the author concluded there were no cost savings which could be attributed to improved reliability and maintainability from the NTR.

Nomen:	Transformer, Power	**Aircraft:**	P3
NIIN:	00-132-6892	**Item Cost:**	$139.46
Period:	Jun86 - May88	**Repair Cost:**	N/A

Month	Verified Fails	"O" LVL MH	"I" LVL MH	Total MH	"O" LVL Costs	"I" LVL Costs	Total Labor Costs	Repair Material Costs	Total Costs
JUN	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00
JUL	3	0	168.9	168.9	$0.00	$3,464.14	$3,464.14	$418.38	$3,882.52
AUG	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00
SEP	1	1	30.9	31.9	$17.08	$633.76	$650.84	$139.46	$790.30
OCT	2	5.6	89.9	95.5	$95.65	$1,843.85	$1,939.50	$278.92	$2,218.42
NOV	1	3.2	19.2	22.4	$54.66	$393.79	$448.45	$139.46	$587.91
DEC	1	0	8.4	8.4	$0.00	$172.28	$172.28	$139.46	$311.74
JAN	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00
FEB	1	0	89.7	89.7	$0.00	$1,839.75	$1,839.75	$139.46	$1,979.21
MAR	1	4	31.7	35.7	$68.32	$650.17	$718.49	$139.46	$857.95
APR	3	7.3	194.2	201.5	$124.68	$3,983.04	$4,107.73	$418.38	$4,526.11
MAY	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00
JUN	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00
JUL	3	7.6	168.6	176.2	$137.71	$3,457.99	$3,595.70	$418.38	$4,014.08
AUG	1	8	70.1	78.1	$144.96	$1,437.75	$1,582.71	$139.46	$1,722.17
SEP	1	0	28.5	28.5	$0.00	$584.54	$584.54	$139.46	$724.00
OCT	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00
NOV	1	5	4.6	9.6	$90.60	$94.35	$184.95	$139.46	$324.41
DEC	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00
JAN	1	7.4	6.9	14.3	$134.09	$141.52	$275.61	$139.46	$415.07
FEB	1	1.3	67.9	69.2	$23.56	$1,392.63	$1,416.19	$139.46	$1,555.65
MAR	3	9.1	300.2	309.3	$164.89	$6,157.10	$6,321.99	$418.38	$6,740.37
APR	6	17.3	243.7	261	$313.48	$4,998.29	$5,311.76	$836.76	$6,148.52
MAY	2	12.3	44.1	56.4	$222.88	$904.49	$1,127.37	$278.92	$1,406.29

Figure 5.15. NTR Serial Number 9124/06 Maintenance Data

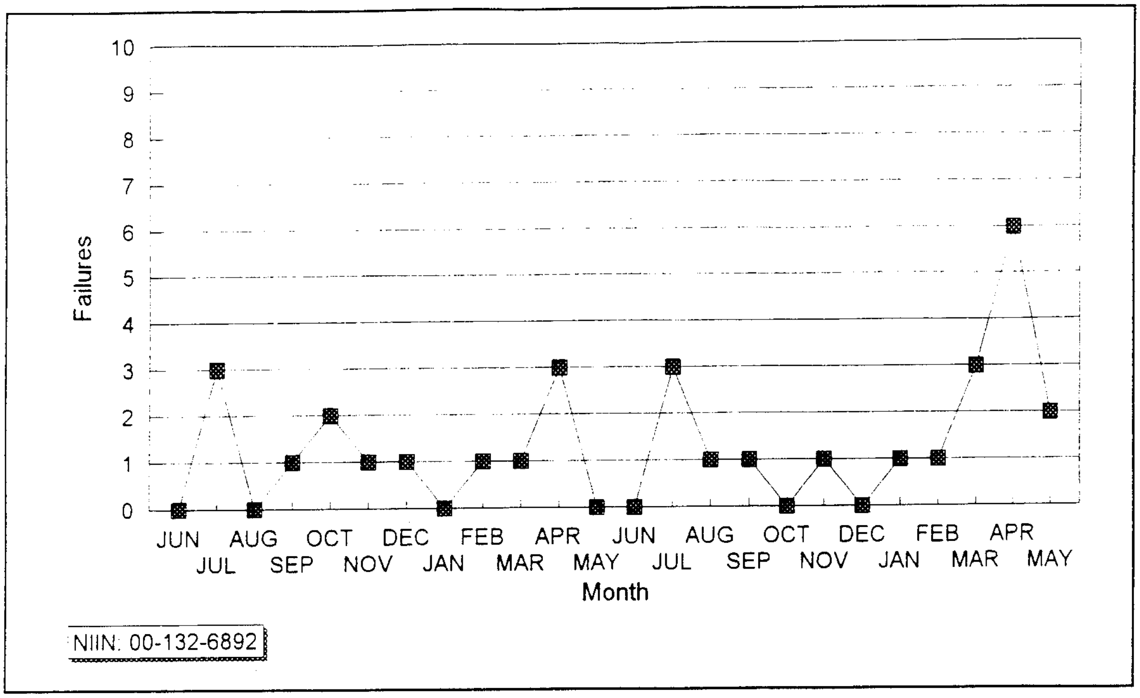

Figure 5.16. NTR Serial Number 9124/06 Failure Data

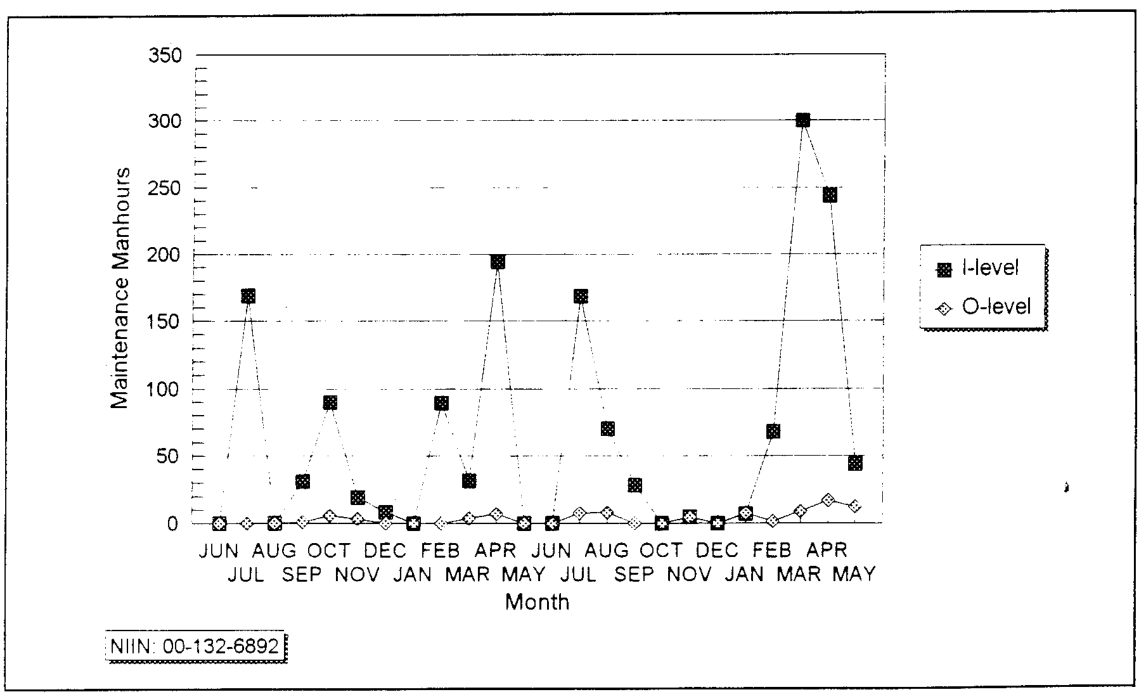

Figure 5.17. NTR Serial Number 9124/02 Maintenance Manhour Data

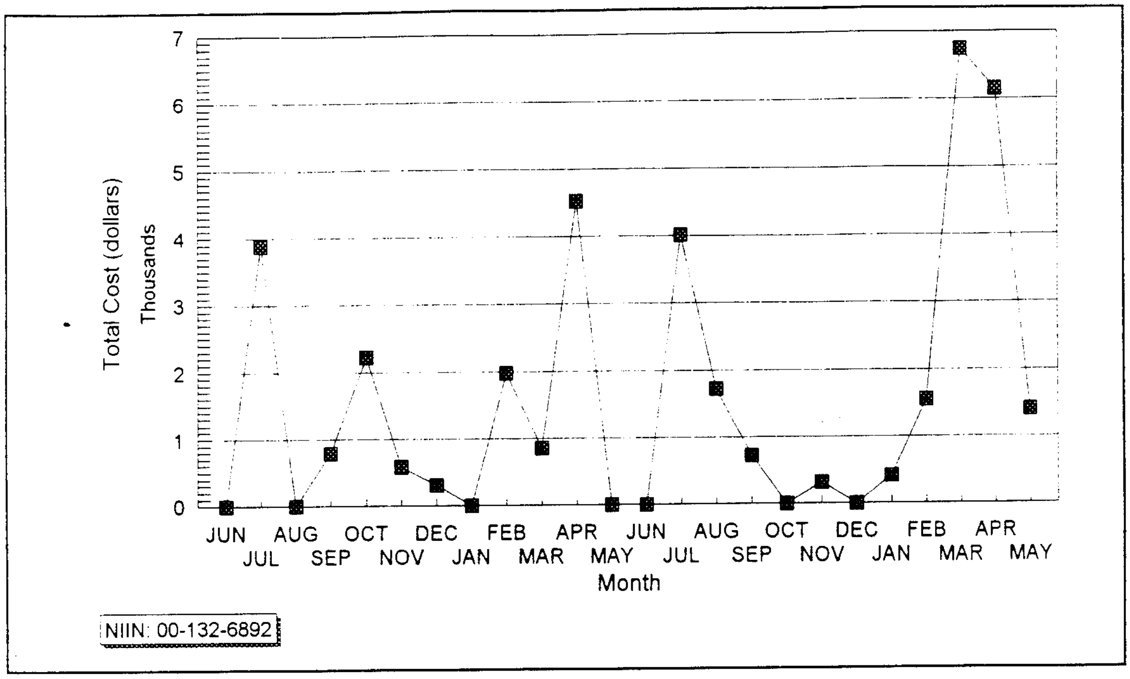

Figure 5.18. NTR Serial Number 9124/02 Repair Cost Data

F. NTR SERIAL NUMBER 7986/09

Report Date: 22 September 1987

Author: Thomas R. Montgomery

Activity: NAESU Detachment North Island, California

Discussion: The sonobuoy gate actuator, part number DL1020M259, used on the H-3 aircraft was previously repaired at the depot level only. The source, maintenance and recoverability code was subsequently changed to allow I-level maintenance activities to perform maintenance on this item. It was estimated that a 90 percent RFI rate would be realized from this action. Unfortunately, the technical publications that outline repair procedures were not provided to the intermediate maintenance activities. The report recommended the CFA provide necessary publications for the item. [Refs. 31 and 32]

Analysis: Initial review of maintenance data (see Figure 5.20) before and after the NTR was submitted did not reveal a trend of reduced equipment failures or reduced maintenance manhours at either the O- or I-level activities. Failures remained at an average of 8.8 per month (Figure 5.21), O-level maintenance manhours averaged 30 per month, while the number of I-level maintenance manhours averaged 37.4 per month(Figure 5.22). The number of BCMs averaged 2.3 per month. Total repair costs remained relatively constant throughout the period of interest (Figure 5.23). Based upon the maintenance data, the author could show no appreciable cost savings which could be attributed to improved reliability or maintainability from the NTR.

Nomen: Valve, Relief, Pressure and Temperature
NIIN: 00-504-2650
Period: Dec88 - Nov90

Aircraft: F14
Item Cost: $2,474.00
Repair Cost: $2,165.00

Month	Verified Fails	"O" LVL MH	"I" LVL MH	Total MH	"O" LVL Costs	"I" LVL Costs	Total Labor Costs	"I" LVL Repairs	BCMs	Depot Repair Costs	Total Costs
DEC	6	2	0	2	$34.16	$0.00	$34.16	1	0	$0.00	$34.16
JAN	6	0	0	0	$0.00	$0.00	$0.00	0	0	$0.00	$0.00
FEB	2	0	0	0	$0.00	$0.00	$0.00	0	0	$0.00	$0.00
MAR	5	0	0	0	$0.00	$0.00	$0.00	0	0	$0.00	$0.00
APR	3	0	0	0	$0.00	$0.00	$0.00	0	0	$0.00	$0.00
MAY	0	0	0	0	$0.00	$0.00	$0.00	0	0	$0.00	$0.00
JUN	2	0	0	0	$0.00	$0.00	$0.00	0	0	$0.00	$0.00
JUL	1	1	0	1	$17.08	$0.00	$17.08	1	0	$0.00	$17.08
AUG	2	0	0	0	$0.00	$0.00	$0.00	0	0	$0.00	$0.00
SEP	6	0	0	0	$0.00	$0.00	$0.00	0	0	$0.00	$0.00
OCT	3	0	0	0	$0.00	$0.00	$0.00	0	0	$0.00	$0.00
NOV	1	0	4.5	4.5	$0.00	$92.30	$92.30	1	0	$0.00	$92.30
DEC	5	0	0	0	$0.00	$0.00	$0.00	0	0	$0.00	$0.00
JAN	3	1.8	0	1.8	$32.62	$0.00	$32.62	0	0	$0.00	$32.62
FEB	4	0	0	0	$0.00	$0.00	$0.00	0	0	$0.00	$0.00
MAR	4	0	0	0	$0.00	$0.00	$0.00	0	0	$0.00	$0.00
APR	3	0	0	0	$0.00	$0.00	$0.00	0	0	$0.00	$0.00
MAY	3	0	0	0	$0.00	$0.00	$0.00	0	0	$0.00	$0.00
JUN	4	0	0	0	$0.00	$0.00	$0.00	0	0	$0.00	$0.00
JUL	6	0	0	0	$0.00	$0.00	$0.00	0	0	$0.00	$0.00
AUG	2	0	0	0	$0.00	$0.00	$0.00	0	0	$0.00	$0.00
SEP	5	0	0	0	$0.00	$0.00	$0.00	0	1	$2,165.00	$2,165.00
OCT	2	0	0	0	$0.00	$0.00	$0.00	0	0	$0.00	$0.00
NOV	1	0	0	0	$0.00	$0.00	$0.00	0	0	$0.00	$0.00

Figure 5.19. NTR Serial Number 8821/06 Maintenance Data

Nomen: Actuator, Electro-Mechanical
NIIN: 00-119-3185
Period: Sep86 -Aug88

Aircraft: H3
Item Cost: $1,036 14
Repair Cost $703 00

Month	Verified Fails	"O" LVL MH	"I" LVL MH	Total MH	"O" LVL Costs	"I" LVL Costs	Total Labor Costs	BCMs	Depot Repair Costs	Total Costs
SEP	11	53.7	36.9	90.6	$917.20	$756.82	$1,674.02	4	$2,812.40	$4,486.42
OCT	10	59.2	45.6	104.8	$1,011.14	$935.26	$1,946.39	2	$1,406 20	$3,352 59
NOV	4	27.1	21	48.1	$462.87	$430.71	$893.58	1	$703 10	$1,596.68
DEC	5	10.9	15.6	26.5	$186.17	$319.96	$506.13	1	$703 10	$1,209.23
JAN	15	57 8	51.5	109.3	$987.22	$1,056.27	$2,043.49	2	$1,406 20	$3,449 69
FEB	9	26.2	55.2	81.4	$447.50	$1,132.15	$1,579.65	4	$2,812.40	$4,392.05
MAR	9	25.6	37.4	63	$437.25	$767.07	$1,204.32	2	$1,406 20	$2,610 52
APR	7	18	15.6	33.6	$307.44	$319.96	$627.40	1	$703.10	$1,330.50
MAY	7	19.4	3.7	23.1	$331.35	$75.89	$407.24	1	$703.10	$1,110.34
JUN	6	16.2	44.7	60.9	$276.70	$916.80	$1,193.49	3	$2,109 30	$3,302 79
JUL	3	12.5	27.1	39.6	$213.50	$555.82	$769.32	1	$703.10	$1,472 42
AUG	8	26.4	41.2	67.6	$450.91	$845.01	$1,295.92	2	$1,406.20	$2,702.12
SEP	10	41.2	33.5	75.8	$746.54	$716.57	$1,463.11	1	$703.10	$2,166.21
OCT	5	22.7	34.6	40.4	$411 32	$363.03	$774.35	3	$2,109.30	$2,883.65
NOV	5	28.8	17.7	46.6	$521.86	$365.08	$886.93	5	$3,515.50	$4,402.43
DEC	7	31.4	17.8	154	$568.97	$2,514.53	$3,083.49	3	$2,109.30	$5,192.79
JAN	11	36.2	122.6	88.6	$655.94	$1,074.72	$1,730.67	0	$0.00	$1,730.67
FEB	4	17.5	52.4	70.6	$317.10	$1,089.08	$1,406.18	1	$703.10	$2,109.28
MAR	7	26.1	53.1	78.2	$472.93	$1,068.57	$1,541.50	5	$3,515.50	$5,057.00
APR	12	29.3	52.1	76.2	$530.92	$961.92	$1,492.84	4	$2,812.40	$4,305.24
MAY	17	62.3	46.9	114.7	$1,128.88	$1,074.72	$2,203.60	3	$2,109.30	$4,312.90
JUN	12	20.2	52.4	38.6	$366.02	$377.38	$743.41	3	$2,109.30	$2,852.71
JUL	12	32.5	18.4	34.1	$588.90	$32.82	$621.72	2	$1,406.20	$2,027.92
AUG	3	9.7	1.6	11.3	$175.76	$32.82	$208.58	0	$0.00	$208.58

Figure 5.20. NTR Serial Number 7986/09 Maintenance Data

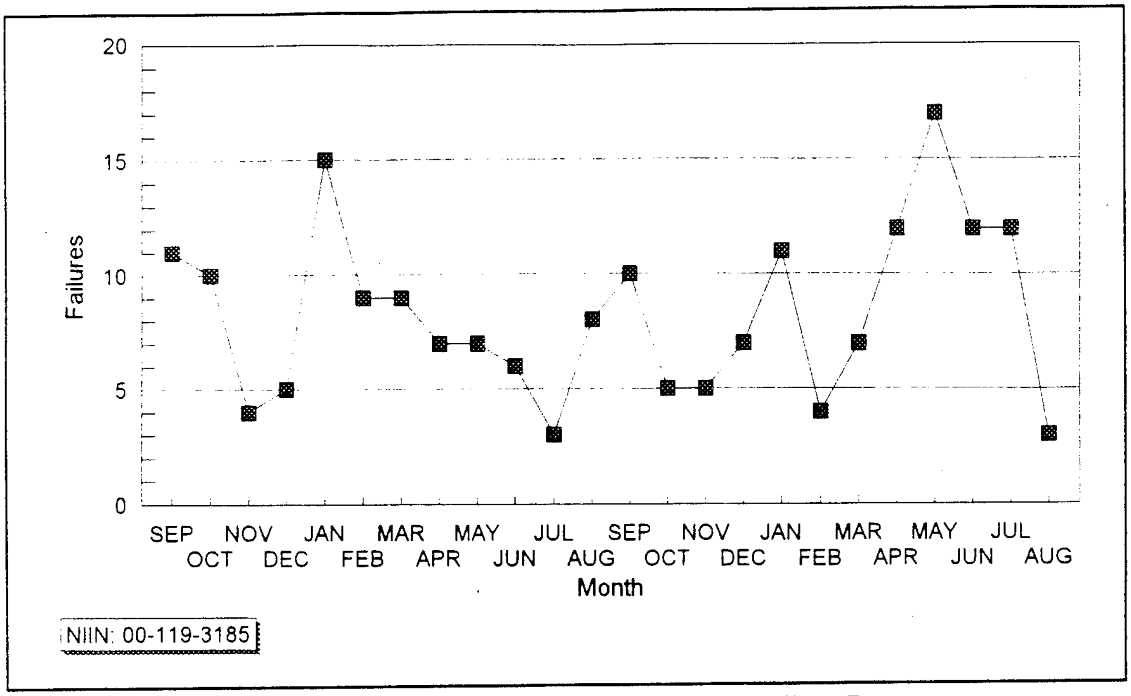

Figure 5.21. NTR Serial Number 7986/09 Failure Data

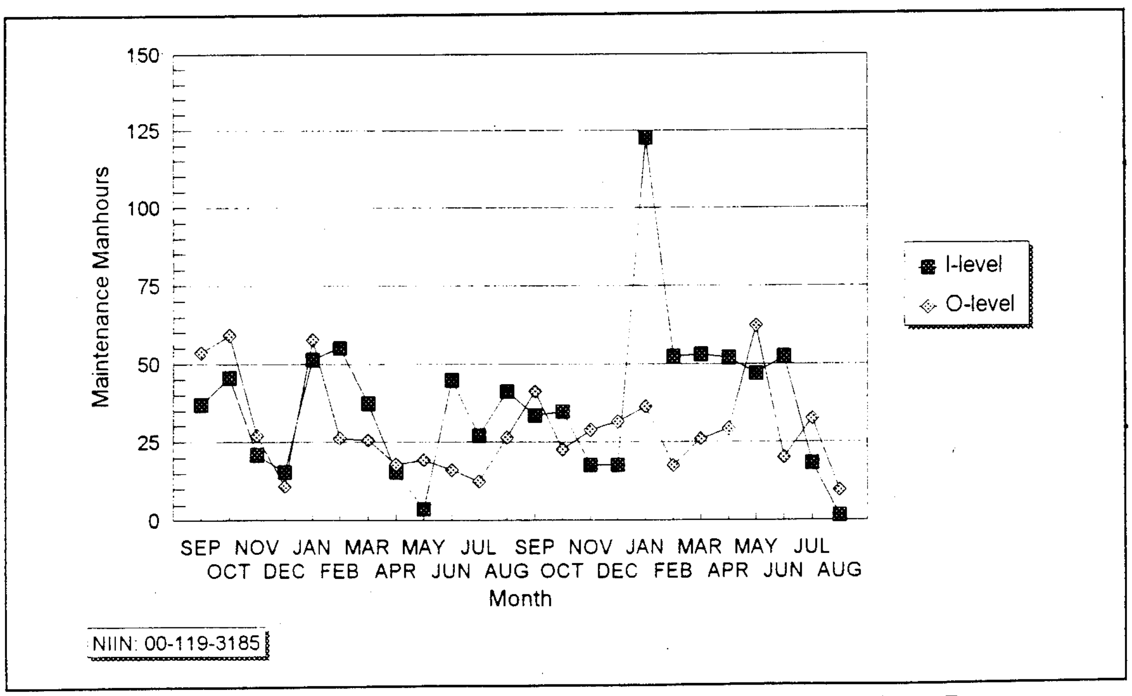

Figure 5.22. NTR Serial Number 7986/09 Maintenance Manhour Data

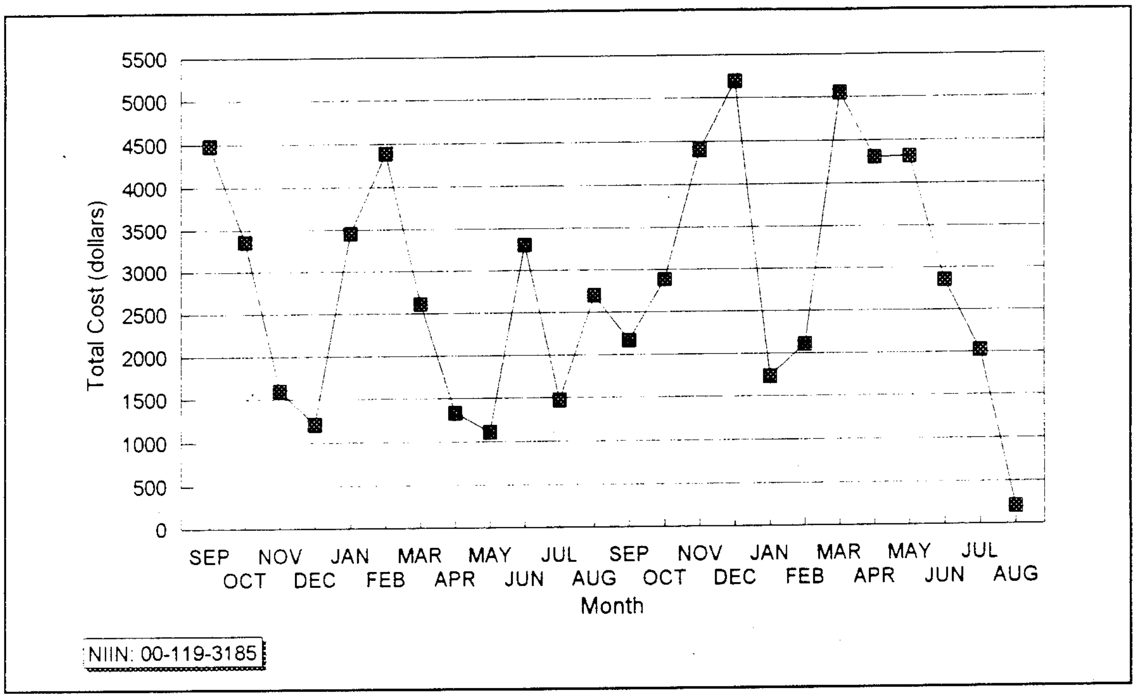

Figure 5.23. NTR Serial Number 7986/09 Repair Cost Data

VI. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The objectives of this thesis were to:

- Describe the process by which techreps provide inputs for improvements to maintenance procedures, and modifications to aircraft weapons systems.
- Examine the NAESU Technical Report Record and Retrieval System data base to extract detailed information on those NAESU technical reports which relate to aircraft weapons systems and to identify problems associated with gathering meaningful information from the data base.
- Examine data bases available for extracting reliability and maintainability information concerning aircraft weapons systems and to identify problems associated with gathering meaningful information from these data bases.
- Determine the cost savings from improvements in reliability and maintainability of a sampling of NAESU technical reports for aircraft weapons systems.
- Refine the methodology for analyzing NAESU technical reports for determination of their contribution to cost savings in the Naval Aviation community.

To achieve the objectives of this thesis, six NTRs were selected for analysis. Each NTR selected resulted in a CFA approved maintenance procedure/publication change. Chapter I provided the nature of the Federal Government agency performance issue and the motivation for NAESU performance measures research. Chapter I also provided thesis objectives, the primary thesis question, scope, literature review and organization for study. Chapter II oriented the reader to specific background information concerning NAESU and Engineering Technical Services. Chapter II further described the reporting and processing of NTRs through the CFA, as well as an introduction to measures of performance used in this thesis. Chapter III detailed the data collection process. Included in Chapter III is the process used to locate NTRs and their respective feedback reports as well as maintenance data. Chapter IV detailed the methodology used by the author in selecting candidates for study and a model for conducting research.

Chapter V presented the data collected from each NTR including specific background information and an analysis of related maintenance data relating to each NTR to determine its effect on the reliability and maintainability of the item, and a determination of its cost savings. Based upon the analysis, the author concluded NTRs can be used as a measure of performance. Use of the research model can determine whether or not the NTR has provided a tangible cost savings through improvements in reliability and maintainability of an aircraft weapons system.

A. CONCLUSIONS

From the results of the analysis conducted in Chapter V, the author concluded the following:

- NTR Serial Number 9388/02 realizes a cost savings through improved maintainability of the equipment. Changing the maintenance level from the D-level to the I-level has saved significant amounts of financial resources and will continue to do so throughout the lifetime of the item.

- NTR Serial Number 8672/15 realizes minor cost savings through improved reliability and maintainability. From maintenance data, both failure rate and maintenance manhours show a downward trend which relate to cost savings throughout the lifetime of this item.

- NTR Serial Number 8629/09 has not contributed any improvements in reliability or maintainability, nor any related cost savings from available maintenance data.

- NTR Serial Number 9124/02 has not contributed any improvements in reliability or maintainability, nor any related cost savings from available maintenance data.

- NTR Serial Number 8821/06 has not contributed any improvements in reliability or maintainability, nor any related cost savings from available maintenance data.

- NTR Serial Number 7986/09 has not contributed any improvements in reliability or maintainability, nor any related cost savings from available maintenance data.

Clearly the issue of how to measure the performance of NAESU is a complex process. Determining improvements in the reliability and maintainability of equipment and associated cost savings from NTRs is quite difficult. Complicating this process is the difficulty in obtaining detailed maintenance data concerning the aircraft weapon's system addressed in each NTR. Because this thesis only examines a sample of NTRs, assuming no other changes have been incorporated on the aircraft weapons system, the reader is cautioned against interpreting the results of this study as wholly conclusive. In fact, the limitations on this study presented in Chapter I preclude this. Rather, it shows a model for undertaking the task of determining whether or not the NTR has provided a tangible cost savings through improvements in reliability and maintainability of an aircraft weapons system.

B. RECOMMENDATIONS

The following recommendations are offered by the author as a result of this thesis effort. First, pursue the methodology used in this thesis in order to examine different NTRs in terms of historical actions which can then be used to support the measures of performance used in this thesis. Periods of interest should be expanded a minimum of five years beyond the date of the NTR so as to include any major change initiated by the NTR. Labor costs and material costs for repair at all three levels of maintenance can pale against those incurred from a major change. This methodology can be expanded to cost savings associated with ECPs as the author discussed previously. Projected improvements in reliability and maintainability are readily available from program managers when changes are approved.

Second, consideration must be given to developing a software program which can be used to easily discern reliability, maintainability and cost data from the maintenance data collection system. This would be most beneficial to management at all levels to determine

what is occurring at fleet maintenance activities. With this information, researchers would have the tools to analyze maintenance actions and evaluate the validity of the maintenance concept.

Third, a comparison between the Navy's Engineering Technical Services program and civilian industry field service representatives might be done to determine what performance measures they use to determine the value of techreps.

Fourth, the author recommends NAESU contact the Fleet Technical Support Center (FTSC), Norfolk, VA. FTSC has contracted out the task of compiling technical reports on CD ROM. This will make access to lessons learned about shipboard weapon's systems maintenance more convenient to all activities confronted with problems which may have already been discussed in technical reports. NAESU could easily negotiate with FTSC for inclusion on this program.

Finally, the author recommends that a minimum of three Naval Postgraduate School computer center employees be educated and trained in the NALDA system. The NALDA data base is the primary source for logistics information for aircraft maintenance activities. The lack of the student's access to or familiarity with NALDA, the funding and time constraints involved in travel by students to NALDA sites (NADEPs, Naval Air Stations, and the Naval Aviation Maintenance Office) for thesis research, and the premium on the time others who currently use NALDA, impair the ability of students who must acquire and use the data now, and in their future assignments as professional logisticians.

APPENDIX A. TECHNICAL REPORTS OF INTEREST

Author	Rpt. No.	Rpt. Date	Pub. Date	CFA	Act. Code	Act. Date	Pgrm.	Nomen.
Allen, D.P.	9366/23	940215	UNKNOWN	NADEP North Island, CA	G	940405	F/A-18	AN/APM-466 RSTS
Allen, D.P.	9366/18	930325	UNKNOWN	NADEP North Island, CA	G	930413	F/A-18	AN/APM-466 RSTS
Allen, D.P.	9366/21	931019	UNKNOWN	NADEP North Island, CA	G	931108	F/A-18	AN/APM-466 RSTS
Allen, D.P.	9366/13	921113	UNKNOWN	NADEP North Island, CA	G	921202	F/A-18	AN/APM-466 RSTS
Allen, D.P.	9366/22	940204	UNKNOWN	NADEP North Island, CA	G	940321	F/A-18	AN/APM-466 RSTS
Allen, D.P.	9366/24	940309	UNKNOWN	NADEP North Island, CA	G	940331	F/A-18	AN/APM-466 RSTS
Allen, D.P.	9366/19	930624	UNKNOWN	NADEP North Island, CA	G	930823	F/A-18	AN/APM-466 RSTS
Anderson, G.	8851/04	861117	870109	NWSC Crane, IN	I	870331	EA-6	POD Hardback Failures
Armstrong, M.S.	9052/02	860508	860801	NADEP Norfolk, VA	3	860723	F-14	Location of Wire Junction
Baker, J.	7453/15	870302	870304	NADEP North Island, CA	B	870412	T-2	C-2645C/AIC-14 ICS
Balanky, J.A.	7229/34	870305	870403	NAEC Lakehurst, NJ	D	870417	GSE	HLU Bomb Hoist
Bell, E.E.	9118/01	861218	870123	NADEP North Island, CA	B	870212	H-53	T64 Eng Brg Oil Nozzle
Bell, E.E.	9118/02	870113	870206	NADEP North Island, CA	B	870220	H-53	T64-GE-416
Bidel, H.C.	7306/21	870916	881008	NADEP North Island, CA	3	880311	E-2	VHF-20B Radio
Bledsoe, G.J.	8632/02	870302	870403	NADEP North Island, CA	B	870507	E-2	MX3160/ASW-15
Bornhorst, D.R.	7749/19	870825	UNKNOWN	NADEP Pensacola, FL	10	880222	H-3	SH-3H Telemetry
Borth, M.R.	7399/32	880317	880513	NADEP Jacksonville, FL	B	880718	F-4	An/APN-194(V) Failures
Boye, A.A.	8729/06	861021	UNKNOWN	NADEP North Island, CA	3	870126	A-6	AN/ALR-45D Analyzer
Bozza, F.J.	7384/37	871022	861107	NAEC Lakehurst, NJ	B	871223	GSE	AERO 47A1/47A
Brown, B.O. ,	7315/24	870820	880205	NADEP Pensacola, FL	F	880222	H-3	SH-3H"E" Radalt
Brown, J.W.	9102/03	861017	870109	NADEP North Island, CA	3	UNKNOWN	GSE	F/A-18 Acft LE Flap
Burgess, W.	8702/04	860223	870306	NAEC Lakehurst, NJ	3	870327	GSE	A/M27T-5
Burgess, W.	8745/05	880105	880212	NAEC Lakehurst, NJ	B	880310	GSE	A/S32K-1 Loader
Call, M.J.	9013/07	870811	871113	NADEP North Island, CA	B	871216	F/A-18	F/A-18 FC Air Data
Call, M.J.	9013/11	871201	880219	NADEP North Island, CA	3	880122	F/A-18	F/A-18 Auto Throttle
Call, M.J.	9013/12	871216	880304	NADEP North Island, CA	B	880219	F/A-18	Aileron, Rudder, LE Flap
Chakerian, J.	7751/50	870129	870320	NADEP North Island, CA	D	870428	H-46	T58-GE-16 FOD
Chakerian, J.	7751/53	870616	870807	NADEP North Island, CA	D	870720	H-46	T2 Servo Piston Wear
Chakerian, J.	7751/49	870108	870320	NADEP North Island, CA	D	870428	H-46	T58-GE-16 Pwr Turbine
Coarsey, R.L.	8676/04	871120	880212	NAEC Lakehurst, NJ	3	880511	S-3	Lox Converter Test Std.
Crawford, J.W.	7314/32	871001	880108	NADEP North Island, CA	3	880308	F-4	AN/APQ-99 Antenna
Dalton, D.L.	7803/32	880120	UNKNOWN	NOCF St. Louis, MS	M	880616	MISC	Alden 9331-N Rcvr
Dalton, D.L.	7803/29	870808	861107	SPAWAR Washington, DC	B	870427	MISC	AN/SMQ-6 Power
Davis, J.G.	7960/11	871002	880108	NADEP Pensacola, FL	B	871112	VAR	AN/APX-100
Davis, R.L.	8741/05	870710	870904	NADEP North Island, CA	3	871215	F/A-18	Duct Assy
Delane, F.H.	8652/05	880620	880826	NADEP Pensacola, FL	B	880802	H-60	AN/ARC-174 Antenna
Dillon, D.F.	7198/45	870720	870918	NAEC Lakehurst, NJ	C	880212	GSE	TMU-70M Lox Trlr.
Dowling, C.A.	8879/08	880204	880325	NADEP Cherry Point, NC	B	880606	C-130	C-130 T56 Hyd Pump
Dressendorfer, H.A.	8671/09	860911	861107	NADEP Alameda, CA	3	870909	P-3	AM-4966/ARR-72
English, W.F.	8717/11	870223	870320	NAEC Lakehurst, NJ	B	870515	GSE	A/S32M-14 Acft Maint
English, W.F.	8717/12	870224	870403	NAEC Lakehurst, NJ	D E	870617	GSE	A/S32M-14 Acft Maint
Ferretti, M.M.	9177/04	870925	871231	NAEC Lakehurst, NJ	3	871218	GSE	Weapons Loader Strtr.
Ferretti, M.M.	9177/05	880225	880513	NAEC Lakehurst, NJ	B	880510	GSE	MMG-2 Voltage Reg.
Ferretti, M.M.	9177/07	880426	880701	NAEC Lakehurst, NJ	A E	880616	GSE	NC-10C and NC-8A

Author	Rpt. No.	Rpt. Date	Pub. Date	CFA	Act. Code	Act. Date	Pgrm.	Nomen.
Ferretti, M.M.	9177/06	880318	880513	NAEC Lakehurst, NJ	M	880527	GSE	A/S32K-1A,B,C
Fichter, J.S.	7593/35	871002	871218	NADEP Jacksonville, FL	F	871210	P-3	MC-2 Compass Cal
Flynn, P.F.	8781/06	890811	UNKNOWN	NADEP Alameda, CA	C	891011	P-3	Aileron/Flap Drop Down
Ford, T.H.	8288/21	881201	880304	NADEP Jacksonville, FL	3	880720	F/A-18	F/A-18 ID-2163 Height
Fountain, J.H.	7489/78	860722	860815	NWSC Crane, IN	3	870313	GSE	Lead-Acid Battery Maint
Fountain, J.H.	7489/80	860126	870206	NAEC Lakehurst, NJ	3	870306	GSE	AHT-63 Hyd Test Stand
Fountain, J.H.	7489/82	871123	880212	NAEC Lakehurst, NJ	1	880308	GSE	A/S32P-16 Fire Truck
Franklin, P.J.	9072/03	870305	871002	NADEP North Island, CA	B	880301	E-2	VHF-20B Shorting Rcpt
Freed, J.W.	7780/28	851002	860110	NWSC Crane, IN	3	871002	GSE	ALM-117
Fuller, J.R.	9043/05	871026	880129	NADEP North Island, CA	B	880208	F/A-18	F/A-18 Fuel Tank O-Ring
Fuller, J.R.	9043/06	880623	880115	NADEP North Island, CA	3	880802	F/A-18	F/A-18 Eng Fuel Valve
Fuller, J.R.	9043/03	870108	870220	NADEP North Island, CA	B	870202	F/A-18	Avionics Cooling Fans
Gayley, J.W.	9098/04	871026	880115	NADEP Alameda, CA	B	880509	P-3	AM6561/ARC-161
Gibson, G.G.	8527/11	880721	880916	NAEC Lakehurst, NJ	C	880930	ENG	F404-GE-400
Graham, D.W.	7928/26	870209	870320	NADEP Alameda, CA	G	870331	SACE	TPS
Groesbeck, D.M.	8878/03	870130	870501	NADEP Cherry Point, NC	D F	870428	H-46	H-46 and HH-46 Gyro
Guernsey, D.L.	8548/10	871116	880115	NWSC Crane, IN	G	880107	EA-6	CIU Testing w/DTB
Guernsey, D.L.	8548/09	861212	UNKNOWN	NWSC Crane, IN	G	870204	EA-6	DF-33A/ALM-117A
Guernsey, D.L.	8548/07	861027	861205	NWSC Crane, IN	G	871211	EA-6	OF-33A/ALM-117A
Guernsey, D.L.	8548/08	861211	UNKNOWN	NWSC Crane, IN	G	870202	EA-6	OF-33A/ALM-117A
Hamblen, R.R.	8853/01	851028	862401	NADEP Norfolk, VA	B	860401	A-6	Fwd and Aft Eng Hoist
Hamblen, R.R.	8853/04	880111	880219	NADEP Norfolk, VA	A C	880302	A-6	Directional Rudder Trim
Hansen, W.M.	7440/32	880316	880527	NATSF Philadelphia, PA	B	880818	P-3	P-3C SASP Glossary
Harkins, J.J.	9023/04	880525	880812	NADEP North Island, CA	B	890421	F/A-18	ALR-67 Coax Cable
Harknett, R.G.	7994/47	880108	880311	NADEP Alameda, CA	3	880226	P-3	MX-8897 Comp. Coils
Hawkins, K.W	9025/02	860603	860725	NADEP Alameda, CA	C	870903	S-3	OL-82A/AYS (ADP)
Healy, D.P.	8672/14	861204	870123	NADEP Pensacola, FL	H	870219	H-3	H-3 Vibrations
Healy, D.P.	8672/15	870126	870306	NADEP Pensacola, FL	D	870428	H-3	Battery Vibration
Herlevic, C.T.	8629/06	860922	861121	NADEP North Island, CA	3	870130	E-2	AN/ALQ-108 Control
Herlevic, T.	8629/07	870706	871016	FCDSSA San Diego, CA	G	880325	E-2	Differential Generator Align
Herlevic, T.	8629/09	880929	881230	NADEP North Island, CA	B	890117	E-2	APS-125 Rigid Coax Instl.
Hinman, P.A.	8905/06	870421	870626	NADEP North Island, CA	3	871216	F/A-18	84J-P059 Connector
Hinman, P.A.	8905/05	870313	870417	NADEP North Island, CA	3	870710	F/A-18	Pitot Static Heaters
Holland, H.A.	8644/30	880516	880715	NAEC Lakehurst, NJ	C	880727	AV-8	A/M37T-23 & A/E37T-14
Hudson, R.M.	7161/37	870707	871204	NESC Charleston, NC	5	880105	MOEP	Altimeter Setting Ind.
Huffines, P.D.	8404/10	861208	870123	NADEP Jacksonville, FL	3	870205	A-6	AN/AAM-60(V4) EOTS
Hurd, R.D.	9140/04	880518	880729	NWSC Crane, IN	G	880630	EA-6	OJ-510/ALM Digital Test
Jeffrey, R.E.	9051/03	870824	871030	NADEP Alameda, CA	A	880307	C-130	GTC-85-180L APU
Johnson, A.J.	7738/14	861203	UNKNOWN	NADEP North Island, CA	B	870122	ENG	Eng. Torque Shaft
Johnson, D.W.	9053/03	880506	880513	NAEC Lakehurst, NJ	A M	880519	GSE	A/M27T Hyd. Pwr. Sup.
Johnson, J.R.	7770/19	861119	880701	NADEP Jacksonville, FL	I	870327	A-6	AN/AAM-60(v)
Jones, G.R.	9083/02	870915	880108	NAVPRO Bethpage, NY	G	880126	CATE	CAT IIID Test Prgm.
Kabarrubias, E.	0665/15	860812	861030	NWSC Crane, IN	A M	861203	EA-6	T-1100/ALQ-99
Kline, J.C.	7764/19	860909	861024	NWSC Crane, IN	A	861230	EA-6	AN/ALQ-97

Author	Rpt. No.	Rpt. Date	Pub. Date	CFA	Act. Code	Act. Date	Pgrm.	Nomen.
Koonce, M.L.	8896/06	880202	880325	NADEP Alameda, CA	10	880711	S-3	S-3A/B Hyd. Reservoir
Kress, L.A.	9124/02	870616	880205	NADEP Alameda, CA	I	870917	P-3	APS-115
Kuester, R.M.	8476/05	890808	910724	NAEC Lakehurst, NJ	A	890927	GSE	A/F32T-10 Doors and Tur
Lammers, J.W.	8821/05	890418	890728	NADEP Norfolk, VA	B	890724	F-14	Lower Arm Brake Swivels
Lammers, J.W.	8821/06	891211	UNKNOWN	NADEP Norfolk, VA	B	891222	F-14	Pressure Operated Pri
Lammers, J.W.	8821/02	850523	850903	NADEP Norfolk, VA	I M	860310	F-14	Vertical Fin/Upper Rudder
Lammers, J.W.	8821/01	850315	850805	NADEP Norfolk, VA	B	850614	F-14	MLG Removal & Replace
Latham, L.	8916/05	870806	871204	NADEP Alameda, CA	10	871217	P-3	P-3 Acft Drain Mast
Latham, L.	8916/06	870806	871218	NADEP Alameda, CA	3	871230	P-3	P-3 Asbestos Seals
Lydon, D.A.	7316/14	870909	871002	NOC St. Louis, MO	G	880126	MOEP	Flexitek Program
Maillet, W.J.	8767/13	900904	911009	NADEP North Island, CA	D	901123	CASP	Grill, Door 3, Gun Gas Exit
Marshall, H.A.	7605/20	871103	880205	NAEC Lakehurst, NJ	C	880120	ENG	TF-34 Thrust Frame
Martin, E.M.	8171/11	870615	870808	SPAWAR Washington, DC	H	870617	MOEP	Wind Measuring Set
Martin, E.M.	6817/13	870629	870807	SPAWAR Washington, DC	C	870629	MOEP	AN/GMQ-27
Martin, T.D.	8982/04	860910	861024	NADEP North Island, CA	3	880122	F/A-18	F/A-18 Speed Brake
Maslowski, A.S.	8803/02	880817	881125	NADEP Jacksonville, CA	B	890124	A-7	Shutdown Procedures
McCracken, L.E.	7884/35	880217	880415	NADEP Cherry Point, NC	10	880328	H-46	In-Flt Engine Restart
McDaniel, L.J.	8826/06	870909	871113	NADEP Jacksonville, FL	B M	871223	A-7	SJU-8/A Ejection Seat
McNulty, J.R.	8768/01	870810	871030	NADEP North Island, CA	3	871221	F-4	F-4S Fuel Qty. Ind.
McPherson, C.R.	8859/04	880330	880610	NADEP Alameda, CA	3	880505	P-3	CU-1777/ARR-72
McQueen, J.F.	8655/05	860731	861107	NADEP North Island, CA	B	870327	F/A-18	F/A-18 Access Doors
Mellott, C.J.	9085/02	870223	870515	NADEP Alameda, CA	3	870623	S-3	S-3A Training Edge Flap
Miller, B.L.	8486/43	921109	UNKNOWN	NAWC AD Lakehurst, NJ	10	931213	CASP	A/M42M-2 Floodlight Set
Miller, B.L.	8486/18	861125	870109	NAEC Lakehurst, NJ	M	870109	GSE	Hydra-Clean 3245
Miller, B.L.	8486/47	931100	UNKNOWN	NAWC AD Lakehurst, NJ	I M	940602	CASP	A/S-32-1D Loader, Air
Miller, B.L.	8486/41	920721	930728	NAWC AD Lakehurst, NJ	B	921120	CASP	A/S32A-30 Tow Tractor
Miller, B.L.	8486/38	911122	920514	NAEC Lakehurst, NJ	A E	911209	CASP	HSU-1, 3 Gallon
Miller, B.L.	8486/23	880212	880429	NAEC Lakehurst, NJ	M	880314	GSE	A/M32C Air Conditioner
Miller, B.L.	8486/26	871103	890526	NAEC Lakehurst, NJ	3	871216	GSE	B-1 Acft. Maint. Stand
Miller, B.L.	8486/27	891106	910502	NAEC Lakehurst, NJ	A E	900124	GSE	ETU-110/E, Acft Eng Trlr
Miller, B.L.	8486/36	910925	911009	NAEC Lakehurst, NJ	0	911127	CASP	A/S32A-30 Tow Tractor
Miller, B.L.	8486/46	930527	UNKNOWN	NAWC AD Lakehurst, NJ	C	930820	GSE	ACU-20/M Compressor
Miller, B.L.	8486/44	921222	UNKNOWN	NAWC AD Lakehurst, NJ	C	930527	GSE	A/S32K-1 Loader, Air
Miller, B.L.	8286/22	871103	880129	NAEC Lakehurst, NJ	C	880621	GSE	B-1 Stand
Miller, G.C.	8744/09	870404	880527	NADEP Cherry Point, NC	B	880629	H-46	HH-46D Generator Phase
Miller, G.C.	8744/04	861230	UNKNOWN	NADEP Cherry Point, NC	H	870122	H-46	H-46 AFCS Discrepancies
Miller, G.C.	8744/08	871216	880212	NADEP Cherry Point, NC	C	880123	H-46	H-46 Elec. Connector
Mixson, R.J.	7299/19	870106	870220	NADEP North Island, CA	3	870326	P-3	T-1129B/URT-26(V)
Mobley, R.W.	7810/31	880706	880812	NADEP North Island, CA	A	880728	F/A-18	Publication Errors
Mobley, R.W.	7810/32	881109	890303	NADEP North Island, CA	3	881216	F-4	Improper Handling and
Montgomery, T.R.	7986/09	870922	880129	NADEP Pensacola, FL	E	880203	H-3	Sonobuoy Gate Actuator
Moore, R.P.	7958/16	860828	UNKNOWN	NADEP Norfolk, VA	B	870116	A-6	Submatrix Relay Module
Mueller, C.W.	8849/06	870128	870306	NADEP North Island, CA	C	870319	F/A-18	F/A-18 AFCS An/ASW-44
Mueller, C.W.	8849/09	880620	880826	NADEP North Island, CA	B	880818	WSI	Bar Alt Indicating System

Author	Rpt. No.	Rpt. Date	Pub. Date	CFA	Act. Code	Act. Date	Pgrm.	Nomen.
Neal, M.	7886/54	880720	880729	NADEP Pensacola, FL	B	880804	H-60	Magnetic Tape Memory
Parker, J.L.	8946/02	870324	870515	NADEP Alameda, CA	B	870611	S-3	TF34-GE-400/A/B
Pecora, J.E.	8848/14	870306	870320	NADEP Jacksonville, FL	J	870331	A-7	Acft Accelerometer; A-7
Phillips, K.A.	8665/12	880923	870515	NADEP Jacksonville, CA	B	880309	CATE	AN/USM-458B Signal
Pierson, W.G.	8897/04	860902	861107	NWS Seal Beach, CA	3	870209	GSE	AN/AWM-38(V) Cal
Pierson, W.G.	8897/07	880318	880729	NWS Seal Beach, CA	3	880721	P-3	AN/AWM-38(V)
Pinkava, C.F.	9388/02	940422	UNKNOWN	NADEP Alameda, CA	C K	940516	P-3	R-2217/ARN-140
Pitts, K.A.	8927/03	870930	880205	NADEP Jacksonville, FL	3	880314	PME	HSI Synchro Rcvr. Sub.
Reed, R.L.	8008/07	870205	871002	NWSC Crane, IN	3	871028	CATE	AN/ALM-199 Test Set
Reno, R.J.	8792/07	861203	870123	NAVAIR Washington, DC	D	870226	NDI	NDT-25N Eddy Current
Rheuark, E.C.	7857/11	860714	860815	NADEP North Island, CA	3	870112	H-53	HD-615/ARC-51
Rogers, L.C.	9037/05	880610	880812	NADEP Pensacola, FL	B	880713	H-53	H-53 Eng. Air Particle
Rogers, T.J.	8974/12	880324	880513	NADEP North Island, CA	3	880606	F/A-18	MLG Shock Absorber Pin
Rogers, T.J.	8974/07	870126	870206	NADEP North Island, CA	3	870318	F/A-18	Canopy Fittings, Latches
Rogers, T.J.	8974/08	870127	870306	NADEP North Island, CA	D	870227	F/A-18	Rt. Leading Edge Seal
Rogers, T.J.	8974/13	880406	880527	NADEP North Island, CA	C	880708	F/A-18	Cabin Exit controller
Ruth, D.J.	8987/08	880415	880527	NADEP Cherry Point, NC	3	880620	C-130	KC-130 Bonding Jumper
Seer, W.B.	7962/22	860902	861121	NADEP Pensacola, FL	B	870527	A-4	A-4 Fuel Line Restrictor
Seibold, A.W.	8972/05	870410	870626	NESSEC Washington, DC	C	870713	P-3	TSEC/KY-58 Battery
Selepec, G.A.	8049/27	870506	870612	NAEC Lakehurst, NJ	M	870628	GSE	Slip Ring
Selepec, G.A.	8049/29	880302	UNKNOWN	NAEC Lakehurst, NJ	A	880509	GSE	Throttle Arm
Selepec, G.A.	8049/30	880601	880729	NAEC Lakehurst, NJ	M	880708	GSE	Starter Motor
Soliz, D.	8580/05	880125	880325	NAEC Lakehurst, NJ	L	880226	F/A-18	USM-470(V)1 Circuit
Solt, H.T.	7978/16	870821	871120	NWSC Crane, IN	B	871210	EA-6	AN/ALM-138
Spinks, J.E.	8713/03	871119	880212	NAEC Lakehurst, NJ	3	871208	GSE	NF-2 and A/M42M-1
Spinks, J.E.	8713/04	871120	880212	NADC Warminster, PA	3	880101	MISC	Paint Spray Gun Cleaner
Starck, E.G.	8785/04	860505	860711	NADEP Norfolk, VA	B	861001	A-6	Tanker Package TX Check
Starck, E.G.	8785/03	860115	860321	NADEP Norfolk, VA	B	860319	A-6	T5-3002-105-00
Starck, E.G.	8785/08	880802	881110	NADEP Norfolk, VA	B	881024	A-6	A-6/EA-6 Wing External Fu
Stults, L.E.	7762/05	880526	880812	NADEP Norfolk, VA	A	881028	F-14	AN/AWM-23(V) RFTS
Sutherland, H.A.	8962/02	860908	861121	NADEP Jacksonville, CA	A	861023	A-7	Support Assy, Air Cond.
Sutherland, H.A.	8962/03	870306	870417	NADEP North Island, CA	A	870602	F/A-18	Hyd System 1 Supply Tube
Sutherland, H.A.	8962/05	880908	UNKNOWN	NADEP Jacksonville, FL	3	890113	A-7	MLG Indication
Sutherland, H.A.	8962/04	870916	871120	NADEP Alameda, CA	A M	871231	A-6	D-704 Air Refueling Store
Sutherland, H.A.	8962/01	850925	851230	NADEP Jacksonville, CA	A	860407	A-7	Pitch Actuator (AFCS)
Tappan, F.W.	7218/27	870827	871120	NWSC Crane, IN	B	880104	EA-6	OJ-602/ALM Coolant
Tefft, J.W.	8959/04	880220	880513	NADEP North Island, CA	B	880620	H-3	DE-299/AQS-13
Tomasino, T.D.	8903/04	870312	870501	NWSC Crane, IN	H	870512	EA-6	Countermeasure TX
Tournay, R.C.	7235/76	870505	870612	NAEC Lakehurst, NJ	D	870619	GSE	A/M32C-17 Mobile A/C
Tournay, R.C.	7235/73	870128	870206	NAEC Lakehurst, NJ	3	870316	GSE	A/M27T-5
Tournay, R.C.	7235/80	871105	880129	NAEC Lakehurst, NJ	10	871230	GSE	A/M27T-7 Temp. Ctrl.
Tyler, D.P.	9079/06	871119	880219	NADEP Jacksonville, FL	B	880309	CATE	AN/AAM-60(v)
Valentine, G.H.	8922/06	870811	871002	NADEP Norfolk, VA	B E	871217	GSE	A-6E/EA-6B Slings
Valentine, R.H.	8482/01	870720	871016	NADEP Norfolk, VA	3	880317	F-14	ICS and UHF Radios

Author	Rpt. No.	Rpt. Date	Pub. Date	CFA	Act. Code	Act. Date	Pgrm.	Nomen.
Van Hoven, V C	8883/04	870910	871127	NADEP North Island, CA	3	871221	F/A-18	F/A-18 Eng. Oil Pres.
Wagoner, L.L.	9018/261	900411	UNKNOWN	NAEC Lakehurst, NJ	B C	910128	GSE	45 Ton Axle Jack, A45-20R
Wagoner, L.L.	9018/117	910204	911009	NAEC Lakehurst, NJ	A E	910514	CASP	A/S32A-37 Tow Tractor
Wagoner, L.L.	9018/102	900302	910318	NAEC Lakehurst, NJ	A	900417	CASP	A/M32C-21 Mobile A/C
Wagoner, L.L.	9018/96	890126	890428	NAEC Lakehurst, NJ	B	890323	CASP	A/S32P-16A Firs Truck
Wagoner, L.L.	9018/82	870112	870206	NAEC Lakehurst, NJ	B	870319	GSE	A/M 32M-28 Acft. Clean
Wagoner, L.L.	9018/124	920513	930728	NAWC AD Lakehurst, NJ	B	920724	CASP	SE Fuel Tank Repairs
Wagoner, L.L.	9018/110	900315	910318	NAEC Lakehurst, NJ	B	900622	CASP	AERO 47A/A1 Weapons
Wagoner, L.L.	9018/100	890823	910318	NAEC Lakehurst, NJ	A	891221	CASP	A/S32A-37 Tow Tractor
Wagoner, L.L.	9018/126	920808	UNKNOWN	NAWC AD Lakehurst, NJ	3	930302	GSE	AERO-47 Weapons Loader
Wagoner, L.L.	9018/121	921001	930728	NAWC AD Lakehurst, NJ	A	920609	CASP	A/S32A-32 (SD-2) Acft
Wagoner, L.L.	9018/112	900500	910716	NAEC Lakehurst, NJ	C	901130	CASP	ADU-435 Pulley Pin Instal
Wagoner, L.L.	9018/104	900104	910318	NAEC Lakehurst, NJ	A	Unknown	CASP	NC-8A/NC-10C Electronic
Wagoner, L.L.	9018/94	880909	890317	NAEC Lakehurst, NJ	B	890124	CASP	A/S32A-30 Tow Tractor
Wagoner, L.L.	9018/88	870914	880205	NAEC Lakehurst, NJ	3	880106	GSE	Albar Towbar
Wagoner, L.L.	9018/125	920716	UNKNOWN	NAWC AD Lakehurst, NJ	UNKNOWN	921123	GSE	A/M42M-2 Winch Cable
Walker, J.B.	8936/03	860915	861128	NADEP Jacksonville, FL	B	870209	A-7	SG-898/APM-331(V)
Wallace, K.M.	7369/50	870116	870306	NAEC Lakehurst, NJ	A	870513	GSE	A/S32M-14 Schematic
Wells, L.L.	7354/18	870924	871218	SPAWAR Washington, DC	B	871221	MOEP	AN/UMQ-5 Wind Meas.
Wilkinson, J.P.	8708/07	861219	860123	NAEC Lakehurst, NJ	B	870204	GSE	A/E32C-45 ECU
Winters, W.E.	7858/09	860916	UNKNOWN	NWSC Crane, IN	G	870109	EA-6	EA-6B Digital Test Bench
Wooten, L.D.	8745/05	870910	871218	NAEC Lakehurst, NJ	3	871207	GSE	Gastech 1314 Detector
Wooten, L.D.	8747/06	880620	880812	NAEC Lakehurst, NJ	B	880810	GSE	Acft Cleaning Machines

APPENDIX B. SAMPLE NAESU TECHNICAL REPORTS INDEX

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TECHNICAL REPORTS LISTED BY AUTHOR

NAME	BADGE & SEQUENCE	REPORT DATE	PUBLISH DATE	CFA	ACTN CODE	ACTION DATE	PROGRAM	LOCATION	NOMENCLATURE	REPORT TITLE
ABESS J.C.	8197/ 6	08/01/89	10/03/91	CHPT	0	10/10/89	F14	OCEANA	AN/APN-154B(V)	TESTING THE AN/APN-154 RADAR BEACON SET
ADAMS J.V.	8981/ 11	05/15/90	07/16/91	ALAM	0	05/22/90	P3	BARBERS	CV-2059/ARN-87	MARGINAL LOCALIZER FLAG CURRENT
ADAMS J.V.	8981/ 12	03/01/91	10/08/91	NOIS	0	03/19/91	AVB	BARBERS	AN/ARM-200	NEED FOR TEST BENCH INSTALLATION
ADAMS J.V.	8981/ 14	06/26/91	10/11/91	ALAM	0	07/09/91	P3	BARBERS	AN/AIC-22(V)	REPLACEMENT OF RECEIVER AMP AR1 IN AN/AIC-22
ADAMS J.V.	8981/ 15	04/03/92	08/14/92	NFLK	0	04/15/92	P3	BARBERS	AN/ARN-52(V)	EARLY FAILURE OF Q703 IN ARN-52
ADAMS J.V.	8981/ 16	04/06/92	08/14/92	ALAM	0	04/15/92	P3	BARBERS	TS-2046/AIC	TS-2046/AIC EXCESS VOLTAGE DROP ON +28 VDC
ADAMS J.V.	8981/ 17	07/13/92	09/21/92	ALAM	0	07/30/92	P3	BARBERS	C-8242/AIC-22(V)	REPLACEMENT OF J101 IN C-8242/AIC-22(V)
ADCOCK O.L.	8253/ 1	11/15/90	09/19/91	NFLK	0	11/16/90	A6	WHIDBEY	AN/USM-482	NO NEED FOR ADDITIONAL FDR TEST-SET IN A6
ALLEN D.P.	9366/ 1	08/29/91	05/08/92	NOIS	0	09/03/91	F18	EL TORO	AN/APM-446	SOFTWARE SUPPORT CHANG 1659 ENTRY POINTS
ALLEN D.P.	9366/ 2	09/10/91	05/08/92	NOIS	0	09/11/91	F18	EL TORO	AN/APM-446	SSC 1659 ENTRY POINT AT T/N 2317
ALLEN D.P.	9366/ 3	10/18/91	05/08/92	NOIS	0	10/18/91	F18	EL TORO	AN/APM-446	TEST PROGRAM FOR 2A6
ALLEN D.P.	9366/ 4	11/12/91	05/08/92	NOIS	2	11/12/91	F18	EL TORO	AN/APM-446	RSTS TESTING OF THE R/E 2A3 CCA
ALLEN D.P.	9366/ 5	01/22/92	05/08/92	NOIS	0	01/27/92	F18	EL TORO	AN/APM-446	RTDP PROGRAM XRSTS30.C
ALLEN D.P.	9366/ 6	02/04/92	05/08/92	NOIS	0	02/11/92	F18	EL TORO	AN/APM-446	ANTENNA BORESIGHT ALIGNMENT TOOL
ALLEN D.P.	9366/ 7	02/24/92	05/08/92	NOIS	0	02/27/92	F18	EL TORO	AN/APM-446	R/E 2A8 DAGC/VFO TEST PROGRAM
ALLEN D.P.	9366/ 8	03/04/92	05/08/92	NOIS	0	03/06/92	F18	EL TORO	AN/APM-446	COMPUTER POWER SUPPLY TEST PROGRAM
ALLEN D.P.	9366/ 9	03/25/92	05/08/92	NOIS	0	03/26/92	F18	EL TORO	AN/APM-446	ANTENNA I.D. CONFIDENCE T/N 702
ALLEN D.P.	9366/ 10	04/10/92	05/08/92	NOIS	0	04/13/92	F18	EL TORO	AN/APM-446	SERVO TEST PROGRAM
ALLEN D.P.	9366/ 11	05/06/92	06/30/93	NOIS	0	05/07/92	F18	EL TORO	AN/APM-446	RTDP POWER CONVERTER TEST PROGRAM

APPENDIX C. ABBREVIATIONS AND ACRONYMS

The following is a list of abbreviations and acronyms as they are used in this thesis:

ACC	Aircraft Controlling Custodian
ACG	Airborne Coordinating Group
ACT ORG	Action Organization
AIMD	Aircraft Intermediate Maintenance Department
APML	Assistant Program Manager for Logistics
ASO	Aviation Supply Office
AT	Action Taken
BCM	Beyond Capability of Maintenance
BUNO	Bureau Number
CETS	Contractor Engineering Technical Services
CFA	Cognizant Field Activity
CFS	Contractor Field Service
CFSC	Contractor Field Service, Competitive
CFSP	Contractor Field Service, Prime
CIP	Component Improvement Program
CPS	Contractor Plant Services
DOD	Department of Defense
ECA	Equipment Condition Analysis
ECP	Engineering Change Proposal
EI	Engineering Investigation
EMT	Elapsed Maintenance Time
ETS	Engineering and Technical Services
FTSC	Fleet Technical Support Center
GS	General Schedule
HMR	Hazardous Material Report

ILS	Integrated Logistics Support
ISE/RCM	In-Service/Reliability Centered Maintenance
MAL	Malfunction
MC	Meter Code
MFG	Manufacturer
ML	Maintenance Level
NADEP	Naval Aviation Depot
NAESU	Naval Aviation Engineering Service Unit
NALDA	Naval Aviation Logistics Data Analysis
NAMDRP	Naval Aviation Maintenance Discrepancy Reporting Program
NAVAIR	Naval Air Systems Command
NBR	Number
NCTS	Navy Civilian Technical Specialists
NETS	Navy Engineering Technical Service
NMTS	Navy Military Technical Specialists
NSD	Navy Support Date
NTR	NAESU Technical Report
OMB	Office of Management and Budget
PI	Position Indicator
QDR	Quality Deficiency Report
TEC	Type Equipment Code
TECHREP	Technical Representative
TM	Type Maintenance
TPDR	Technical Publication Deficiency Report
TYCOM	Type Commander
VAMOSC	Visibility and Management of Operations and Support Cost
WD	When Discovered
WUC	Work Unit Code

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